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## Uppermost Albian biostratigraphy and chronostratigraphy

## Robert W. SCOTT<sup>1</sup>

**Abstract:** The Albian Stage is the highest chronostratigraphic unit of the Lower Cretaceous Series and underlies the Cenomanian Stage of the Upper Cretaceous Series. The Albian is divided into three substages, each of which is composed of two or three zones based on distinctive and phylogenetically related ammonite assemblages. The uppermost zone of the Upper Albian Substage, the *Stoliczkaia dispar* Zone, is found in many Western European condensed sections. The ammonite assemblage in the thin glauconitic sandstone near La Vraconne, Switzerland, was defined as the 'Vraconnian Stage' in 1868. However this concept has been little used and was abandoned in 1963 as part of the Cretaceous chronostratigraphic scale. A recent proposal to resurrect and redefine this stage is based on a number of criteria and very detailed and reliable stratigraphic data. A quantitative biostratigraphic analysis of the ammonite ranges in the key sections shows that the proposed subzones of the *S. dispar* Zone have discordant ranges. Furthermore, the utility of a 'Vraconnian Stage' between the Albian and Cenomanian stages is geographically limited and the concept embraces one of many depositional sequence cycles of the Albian. The reinstatement of a 'Vraconnian Stage' is not recommended.

**Key Words:** Albian; Vraconnian; ammonites; planktic foraminifers; graphic correlation; age calibration.

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Résumé : Biostratigraphie et chronostratigraphie de l'Albien sommital/terminal.- L'étage Albien constitue l'unité chronostratigraphique la plus élevée du Crétacé inférieur et repose sous l'étage Cénomanien du Crétacé supérieur. L'Albien est divisé en trois sous-étages, chacun comprenant deux ou trois zones établies sur des associations d'ammonites distinctes mais phylogénétiquement reliées. La zone sommitale du sous-étage Albien supérieur, la Zone à Stoliczkaia dispar, a été identifiée au sein de nombreuses séries condensées en Europe occidentale. L'association d'ammonite reconnue dans le mince niveau de grès glauconieux des environs de La Vraconne (Suisse) a été définie comme 'étage Vraconnien' en 1868. Toutefois ce concept a été peu usité et fut abandonné en 1963 en tant qu'unité de l'échelle chronostratigraphique du Crétacé. Il a été récemment proposé de réhabiliter et de redéfinir cet étage sur la base d'un certain nombre de critères et de données stratigraphiques très détaillées et fiables. Or une analyse biostratigraphique quantitative des répartitions des ammonites dans les coupes clefs révèle que les sous-zones proposées pour la subdivision de la Zone à S. dispar correspondent à des intervalles non concordants. En outre l'intérêt de placer un 'étage Vraconnien' entre les étages Albien et Cénomanien apparaît géographiquement limité, et le concept correspond à une seule des nombreuses séquences de dépôt de l'Albien. Il n'est donc pas recommandé de restaurer un 'étage Vraconnien'.

**Mots-Clefs** : Albien ; Vraconnien ; ammonites ; foraminifères planctoniques ; correlation graphique ; calibration des âges.

## Introduction

Recently AMÉDRO (2002, 2008), AMÉDRO & ROBASZYNSKI (2008) and ROBASZYNSKI *et alii* (2007) proposed to reinstate the 'Vraconnian Stage' between the Albian and Cenomanian stages. This proposition, which would significantly modify the Cretaceous geologic column, merits careful and thorough analysis. Our objectives are to provide a testable global biostratigraphic database with which to evaluate the ranges of key uppermost Albian species and to calibrate their ranges to a numerical time scale.

The Cretaceous System is composed of twelve stages that can be correlated world-wide and are of different durations (HANCOCK, 2003). The Albian Stage is the youngest chronostratigraphic unit of the Lower Cretaceous Series and one of the longest Cretaceous stages, about 13 to 15 myr. The Albian Stage was defined by d'ORBIGNY (1840-1842) to include the fossil assemblages in shale and

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glauconite sands cropping out along the Aube River in the Department of Aube on the eastern margin of the Paris Basin (MAGNIEZ-JANNIN & RAT, 1980). A stratotype section along the Aube River was composited from outcrop sections and nearby boreholes (LARCHER *et alii*, 1965; AMÉDRO, 1992). The Albian biota in the Paris Basin is transitional between Boreal and Tethyan realms. The concepts of Albian ammonite zones have evolved over a period of time beginning in 1868 when the "*Ammonites mammillaris*" zone (de RANCE, 1868) (now the Douvilleiceras mammillatum Zone) and the "zone of Ammonites inflatus" (de LAPPARENT, 1868) (now considered equivalent to the Stoliczkaia dispar Zone) were proposed (RAWSON et alii, 1978). The current zonal scheme (Fig. 1) was composed by SPATH (1923) and BREI-STROFFER (1947) and modified by OWEN (1971) and AMÉDRO (1992). The zonal succession has been relatively stable since 1947 and most are interval zones defined by the first appearance of an ammonite species (FO; AMÉDRO, 1992).

mar	nmill	<i>aris</i> " zone (de l Magniez-Jan		Amédro 20	08			
	UPPER			Stoliczkaia dispar	<u>SUBZONES</u> .S. dispar S. blancheti	app enninic a	Arrhaphoceras briacensis M. perinflatum	Vraco nnian
ALBIAN		S. dispar S. dispar S. blancheti			Callihoplites auritus	R. app(	Mortoniceras fallax	Vra(
			C. au ritus H. varicosum H. orbignyi	Mortoniceras	Hysterocera s varicosum	R. tici nensis	M. inflatum	an
		M. inflatum		inflatum	Hysteroceras orbignyi	su bticine nsis oAE1 c	M. pricei	Upper Albia n
					Dipoloceras cristatum	ਕ ਨਾਂ B. breg giensis	D. cristatum	ŋ
	MIDDLE	E. lautus	D. cristatum E. lautus-E. nitidus	<u>TETHYS</u> <u>ZONES</u> Euhoplites lautus	<u>NW EUROPE</u> <u>ZONES</u> A. daviesi E. nitidus			
			M. subdelaruei	Euhoplites	E. meandrinus M. subdelaruei			
		H. dentatus	D. niobe A. intermedius	loricatus	D. niobe A. intermedius			
			H. dentatus H. spathi L. lyelli I. eodentatus	Hoplites dentatus	H. spathi L. Iyelli			
	OWER	O. raulinianus	O. bulliensis O. larcheri	Dou∨illeiceras mammillatum	L. pseudolyelli 6 zones D. perinflata	T. primula		
		S. dutempleana	O. floridum					
	Q		S. kitchini	Leymeriella	L. regularis L. tardefurcata	0AE1b		
		L. tardefurcata	L. regularis H. milletioides F. farnhamensis	tardefurcata	L. schrammeni	*0		

**Figure 1**: Chart comparing three stage and substage concepts of the Albian (P. DESTOMBES, 1979 in MAGNIEZ-JANNIN & RAT, 1980; OGG *et alii*, 2004, and AMÉDRO, 2008). The positions of Albian anoxic events and key microfossils were interpolated by OGG *et alii* (2004).

The Albian Stage is divided into three substages, Lower, Middle and Upper. Although stratotype sections for these substages are yet to be agreed upon, here they are used formally following HART *et alii* (1996) and are capitalized. The zonal boundaries of the substages have been used consistently since 1947 (Fig. 1). Prior to 1947, however, two different criteria were used to define the base of the Upper Albian

Substage. SPATH (1923, 1941) placed the boundary at the top of the *Dipoloceras cristatum* Subzone, which directly overlies the *Euhoplites lautus* Zone (OWEN, 1971). Alternatively BREISTROFFER (1947) placed the Cristatum Subzone in the basal Upper Albian *Mortoniceras inflatum* Zone. This later opinion has been followed since (BIRKELUND *et alii*, 1984; OWEN, 1984a, 1984b; HANCOCK, 1991; HART *et alii*, 1996; RAWSON & HOEDEMAEKER, 1999; HOEDE-MAEKER & RAWSON, 2000; HOEDEMAEKER *et alii*, 2003). The rationale for this change is reviewed by OWEN (1971) and HART *et alii* (1996). In North America a regional transgressive unconformity coincides with the top boundary of the Cristatum Subzone, which is a widespread mappable contact (SCOTT *et alii*, 2003).

The Albian Stage comprises the evolutionary origins and/or diversification of seven families of ammonites. Zones of the Lower, Middle and Upper Albian substages are based mainly on species of the families of Lyelliceratidae, Hoplitidae, and Brancoceratidae. Four heteromorph families first appear in the Albian, Anisoceratidae, Baculitidae, Hamitidae, and Turrilitidae, but are not used to define zones until their appearance in the Upper Cretaceous.

The 'Vraconnian Stage' was proposed by RENEVIER (1868) for a 2 m-thick condensed interval of green glauconitic sand with a distinctive ammonite fauna between the Upper Albian and Lower Cenomanian substages near La Vraconne in western Switzerland. The ammonite assemblage is part of the Stoliczkaia dispar Zone and the lithostratigraphic unit correlates with the Upper Gault and Upper Greensand in England (Fig. 1). This stage was discarded in 1963 (COLLIGNON, 1965; RAWSON et alii, 1978; Налсоск, 1991, 2003, among many others). However the 'Vraconnian Stage' has been resurrected and redefined by AMEDRO (2002, 2008), AMÉDRO & ROBASZYNSKI (2008) and by ROBASZYNSKI et alii (2007). AMÉDRO cites five reasons for recognizing 'Vraconnian' sedimentary strata as a stage between the Albian and Cenomanian stages: (1) the interval is mappable in Western Europe, (2) the interval is a third-order depositional cycle that records an important eustatic event, (3) the interval has a distinctive and diverse fossil assemblage that can be recognized outside Europe, (4) its 2 to 3 myr duration is equivalent to that of the Santonian Stage, and (5) in the Vocontian Basin the interval is more than 100 m thick, which is thicker than the underlying part of the Albian (Amédro, 2002, 2008). Amédro has presented detailed lithostratigraphic and biostratigraphic data of twelve sections in Europe, Tunisia, Madagascar, and California to support his proposal. For the first time he presents a regional lithostratigraphic correlation of many of these sections. HANCOCK (2003) reviewed the history of the rejection of the 'Vraconnian' concept by the community of Lower Cretaceous stratigraphers beginning in 1963 and believed that reasons to revive 'Vraconnian' were "trivial". He noted that most 'Vraconnian' sections are condensed intervals.

As a framework for discussing the wisdom of revising the Albian Stage by reinstating the 'Vraconnian Stage', a review of the stage concept is relevant. "A stage is a chronostratigraphic unit of smaller scope and rank than a series. It is most commonly of greatest use in intra-continental classification and correlation, although it has the potential for worldwide recognition" (NACSN, 2005, р. 1582). As a chronostratigraphic unit the Albian Stage has synchronous boundaries and is the physical evidence or 'material referent' of a time interval, the Albian Age. The Albian Stage has traditionally been defined by a set of ammonite biozones (Fig. 1): d'ORBIGNY, 1840-1842; Spath, 1923; P. & J.-P. Destombes, 1965; OWEN, 1984a, 1984b; HANCOCK, 1991; HART et alii, 1996, among others. The Global Stratotype Section and Point (GSSP) have yet to be selected to define the basal boundary although excellent section has been proposed an (KENNEDY et alii, 2002). The upper boundary of the Albian Stage is defined by the base Cenomanian Stage GSSP at Mont Risou, France (GALE et alii, 1996; KENNEDY et alii, 2004).

## Methodology of integrating biostratigraphic data

The integrated ranges of select ammonites in seven key sections defined three zones of the Vraconnian (AMÉDRO, 2008, Fig. 4; Fig. 1, Table 1). The ranges of key planktic foraminifera in the Tunisian sections and the French Mont Risou section were added to that set of species by ROBASZYNSKI *et alii* (2007). However most of the ammonite species are found in only one or two sections (AMÉDRO, 2008). To test the accuracy of the integration of species ranges the quantitative technique of graphic correlation is used in this report. Graphic correlation (GC) provides an objective method to compare the ranges of species in multiple sections and the outcome can be tested independently.

Graphic correlation (GC) is a quantitative, non-statistical, technique that determines the coeval relationships between two sections by comparing the ranges of event records in both sections (CARNEY & PIERCE, 1995). A graph of any pair of sections is an X/Y plot of the FOs (first appearances) and LOs (last appearances) of taxa found in both sections. The interpreter places a line of correlation (LOC) through the tops and bases that are at their maximum range in both sections. This LOC is the most constrained hypothesis of synchroneity between the two sections and extends the fewest bioevents. The LOC also accounts for hiatuses or faults at stratal discontinuities indicated by the lithostratigraphic record. The position of the LOC is defined by the equation for a regression line. Explanation and examples of the graphic technique are illustrated by MILLER (1977) and CARNEY & PIERCE (1995). By iteratively graphing successive sections a database of species ranges is compiled. The accuracy of these ranges depends on the number of sections, preservation and correct identification of the species. Such a database is testable and the process is transparent so that the fossil occurrence in each section can be evaluated to determine its accuracy. This process compiles data of many specialists who have studied numerous global sections.

Mont Risou, France, Section	FO	LO	Harchies, Belgium		
	meters	meters	Anisoceras perarmatum	-87.1	
Base limestone interval	330 m		Anisoceras pseudoelegans	-95.5	
Actinoceramus sulcatus	50	78	Callihoplites vraconensis	-87.1	
Actinoceramus subsulcatus	25		Hamites virgulatus	-98.4	
Anisoceras salei	78		Hyphoplites subfalcatus (ID cf.)	-86.1	
Anisoceras perarmatum	78		Lepthoplites cantabrigiensis	-102.1	
Arrhaphoceras briacensis	305		Pleurohoplites subvarians	-87.1	
Dipoloceras cristatum	18	25	Strépy, Belgium, Outcrop		
Hysteroceras orbignyi (as sp.)	78		Callihoplites seeleyi	30	
Lechites moreti	155		Callihoplites pulcher	30	
Mantelliceras mantelli		205	Callihoplites tetragonus	20	
Mariella gresslyi	155		Cantabrigites subsimplex	30	
Mortoniceras perinflatum		205	Hyphoplites valbonnensis	20	
Rota globotruncanoides	295		Lechites gaudini		20
Turrilitoides hugardianus	155		Mortoniceras fallax	20	
Folkestone, UK, Section			Neophlycticeras blancheti	20	
Base cenomanian ammonites	38		ANDRA MAR 203 Core, France		
Inoc concentricus	0	10.5	Hamites virgulatus (ID cf.)	-523.23	
Actinoceramus sulcatus	9.7	13	Hyphoplites coelonotus	-776.75	-523.38
Anisoceras perarmatum	26	38	Hyphoplites falcatus	-455.85	020,00
Arrhaphoceras substuderi	26	38	Hyphoplites valbonnensis	-487.17	
Callihoplites auritus	14.5	24.5	Lechites gaudini	-487.17	
Callihoplites cantabrigense	25		Mariella bergeri (ID cf.)	-467.25	
Callihoplites leptus	25		Ostlingoceras puzosianum	-561.54	
Callihoplites tetragonus	26	38	Pleurohoplites renauxianus	-581.8	
Callihoplites vraconensis	26	38	Schloenbachia varians	-430.8	
Hyphoplites coelonotus	25		Diégo core, Madagascar		
Lepthoplites falcoides	26	38	Lechites gaudini	-50	
Mortoniceras inflatum	14.5	25	Mantelliceras mantelli	-23	-5
Pleurohoplites renauxianus	26	38	Mariella bergeri	-20	-5
Merstham, UK			Neostlingoceras carcitanense	-20	-5
Anisoceras picteti	4.7	5	Scaphites simplex	-23	-5
Callihoplites seeleyi	7	7.2	Sciponoceras roto	-54	-5
Callihoplites vraconensis	4.7	7.2	Stoliczkaia dispar	-23	-5
Idohamites elegantulus	4.7	5	Biti breggiensis	-50	-118
Lechites gaudini		7	Planomalina buxtorfi	-215	-110
Lepthoplites falcoides	4.7	5	Planomalina praebuxtorfi	-106	-10 -90
Lepthoplites pseudoplanus	4.7	7.2	Rota appenninica	-118	-90
Mortoniceras alstonensis	4.7	5	Rota appenninca Rota brotzeni	-131 -23	-10
Mortoniceras fallax	4.7	5	Rota protzeni Rota globotruncanoides	-23	-10
Neophlycticeras blancheti	4.7	6.6	Tici praeticinensis		
Ostlingoceras puzosianum	7	7.2		-215	-180
Pleurohoplites renauxianus	7	7.2	Tici primula	-236	-135
			Tici subticinensis	-215	-155
			Tici ticinensis	-180	-106

 Table 1: Biostratigraphic species and ranges in meters of each section from AMÉDRO (2008).

## Integrated Upper Albian chronostratigraphy

#### **Process of Graphic Correlation Experiment**

To begin the GC experiment the Mont Risou section, southeastern France (GALE *et alii*, 1996; Fig. 2) was selected as the standard reference section because it records continuous basin deposition at a uniform rate of accumulation and it yields diverse ammonites, inoceramids, planktic foraminfera, and nannofossils. This section was cross plotted to itself setting its thickness in meters as the relative time scale. Subsequently seven other sections, which yielded precise and abundant biostratigraphic data, were plotted to it through multiple rounds and the ranges of the fossils extended to the thickness scale at Mont Risou. The first section

plotted was the Kalaat Senan, Tunisia (AMÉDRO, 2008, Fig. 20), which spans from uppermost Albian to Cenomanian; this section also represents uniform deposition. The result is that the scale was extended from the base of the Upper Albian to the Cenomanian/Turonian contact.

The second graphed section was the Diégo well, N Madagascar (AméDRO, 2008, Fig. 22). This 300 m cored interval is mainly marl that spans an interval from lowermost Cenomanian to middle Albian (Fig. 3D). The section yields several key planktic foraminifera and in three samples a few ammonites. The LOC of the graph is constrained by a small number of first occurrences and it extends the bases of many foraminifera. The section appears to record continuous Late Albian deposition.

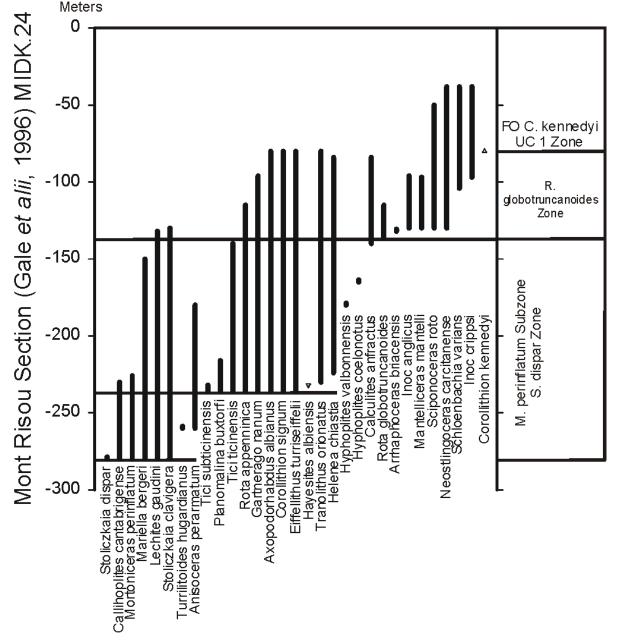
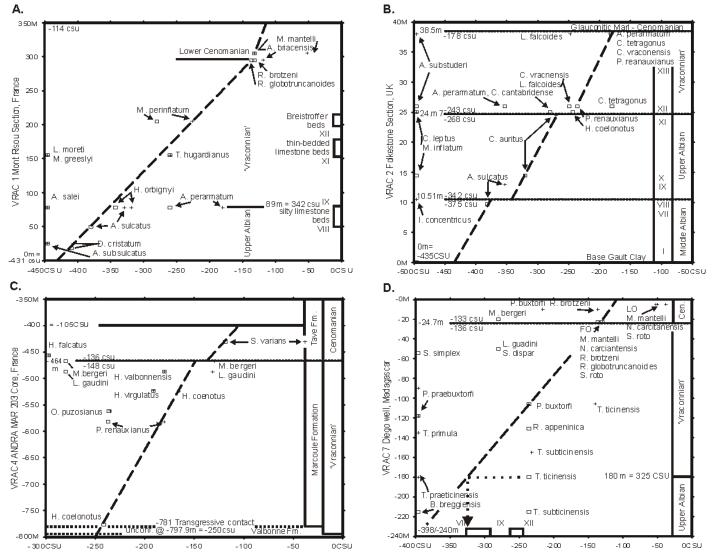


Figure 2: Biostratigraphic range chart of Mont Risou Albian-Cenomanian reference section showing key ammonites, planktic foraminifera and nannofossils (from GALE *et alii*, 1996).

The third section graphed was the cored interval in the ANDRA MAR 203 well (Amédro, 2008, Fig. 8). This interval is about 560 m thick and spans from the Cenomanian to the Aptian stages (Fig. 3C). A significant unconformity, probably a sequence boundary, is at the base of the Albian Valbonne Formation (-827 m), which is a glauconitic sandstone that overlies Aptian marls. A second unconformity, a transgressive contact, is at the base of a phosphatic interval in the upper part of the Valbonne at -797.9 m. The Valbonne grades up into the Marcoule Formation. Biostratigraphic data appear 18 m above this upper break and span an interval about 350 m thick. In this section AMÉDRO placed the base of the 'Vraconnian' at the unconformity in the upper part of the Valbonne so that the 'Vraconnian' is 334 m thick. The LOC of the section is constrained by the FO and LO of Hyphoplites coelonotus and the LOs of

three other ammonites (Fig. 3C). A short hiatus is suggested by the offset of the LOC in the basal Cenomanian. An alternative interpretation is that the interval recorded a reduced rate of sediment accumulation beginning in latest Albian times. At the Marcoule locality the complete section, from its base at -781 m to the base of the Cenomanian at about -464 m, correlates with zones XII-XIII in the near shore Folkestone section, where these same zones are only 13.8 m thick.

The fourth section to be added was the Mont Risou section in AméDRO (2008, Fig. 11), which was based on data from multiple sources including GALE *et alii* (1996). Thus the slope of the LOC is the same as that of the standard reference section. This plot is well constrained by several first and last occurrences; it extends some ranges and it adds three new species not found in other sections (Fig. 3A).



**Figure 3**: Graphic correlation interpretations of four key 'Vraconnian' sections. First occurrences (FO) of species are indicated by a square symbol ( $\Box$ ) and the last occurrence (LO) by a plus sign (+). Superposed symbols of a species indicates a single occurrence. Symbols on the left of the Y axis indicate that the occurrence is only in the section they accompany. CSU is a composite standard unit calibrated in meters to the thickness of the Mont Risou section (file MIDK24). Horizontal solid and dotted lines are stratigraphic contacts; inclined dashed lines project a position in the section into the position of a species in the set of sections in the database of "Vraconnian" sections; these lines are 'lines of correlation' (LOC). Roman numerals indicate ammonite zones in the English sections.

The next section plotted was the Gault Clay in the Folkestone section in Amédro (2008, Fig. 14). This section spans several significant unconformities (Fig. 3B), one at the base of the Gault Clay overlying the Lower Greensand, a second at the condensed interval VIII zone, a third at the XII zone, and the highest at the Albian/Cenomanian contact between the Gault and the glauconitic marl (HART, 2000). The LOC of the lower interval of zones I-VII is poorly constrained at the top by the FO of Actinoceramus sulcatus and its slope is the same as that of the higher LOCs. The unconformity break is placed at the top of zone VIII. The LOC in the next higher interval of zones IX-XI is constrained by the range of *Callihoplites* auritus. In the next higher section of zones XII-XIII the LOC is constrained by several FO and LO bioevents (Fig. 3B). This section plot defines

the relative duration of the hiatus of two unconformities as meter thicknesses in the Mont Risou section; these intervals can now be projected into other graphed sections.

An older ammonite data set from Folkestone by AMÉDRO (1992) is graphed by several FO and LO's. The unconformities are well constrained as in the newer section in AMÉDRO (2008). The Merstham, England (AMÉDRO, 2008, Fig. 15) repeats the uppermost part of the Upper Greensand Formation that is present at Folkestone. The data are confined to two horizons so the LOC is not well constrained. However these data adjust nine FO's and nine LO's. The Strépy and Harches sections were graphed next (AMÉDRO, 2008, Fig. 17) and have limited data so that the LOC of each is not tightly constrained.

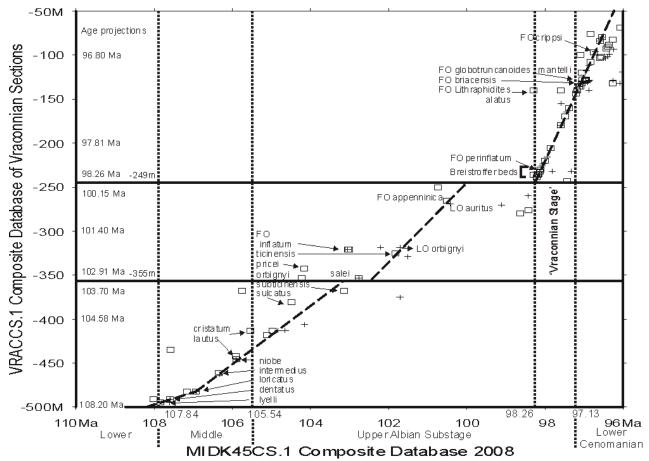


Figure 4: Graphic correlation plot of VRACCS.1 database to the global integrated MIDK45CS.1 database.

#### Process of calibration to numerical ages

The graphic correlation experiment resulted in a list of species and their ranges relative to each other in the metric scale of the Mont Risou section. The next step in the experiment was to convert the metric scale to a numerical age scale in mega-annum units. This was accomplished by plotting the composited range data set of AMÉDRO'S 'Vraconnian' data set, VRACCS.1, to the MIDK45CS.1 composited range data set (Fig. 4). The MIDK45CS.1 data set is the next development stage beyond MIDK3 (SCOTT *et alii*, 2000) and MIDK42CS.1 (SCOTT, in press; see also data of MIDK42 on website precisionstratigraphy.com). It is composed of more than one hundred sections and nearly 3000 bioevents, geochemical events, magnetochrons, and sequence stratigraphic contacts. The scale of this range data set is the numerical time scale of HARLAND *et alii* (1990), as revised by OGG *et alii* (2004), with the exception of the age ascribed the base Cenomanian, 97.13 Ma, because correlations of

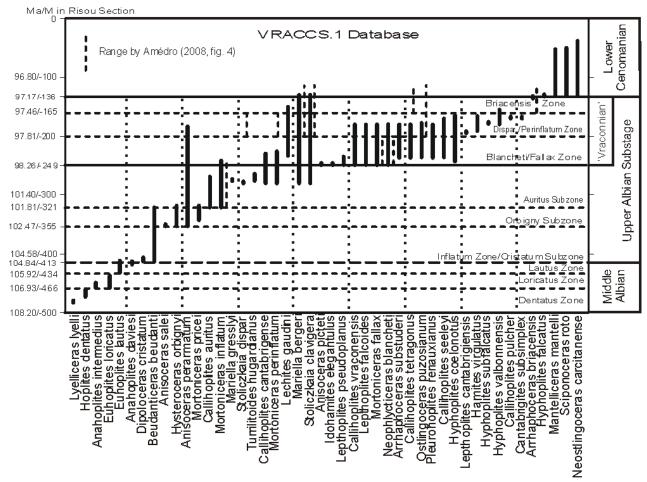
radiometrically dated bentonites and bioevents have been re-evaluated (Овон-Ікиемове *et alii*, 2007).

The two unconformities in the uppermost Albian Upper Greensand Formation are well defined by the data plot (Fig. 4). The two hiatuses separate the VRACCS.1 section into three intervals; the lower break is at -355 meters and the upper break is at -249 meters, which is the base of the 'Vraconnian Stage'. The duration of the lower hiatus is 103.70 to 102.91 Ma, and that of the upper hiatus 100.15 to 98.26 Ma. The LOC of the lower interval is well constrained by numerous bioevents. This lower interval represents two rates of sediment accumulation, a slower basal interval and a faster upper interval. This rate change is indicated by the change in the LOC slope. The LOC of the middle interval is tightly constrained by ammonites and planktic foraminifera. The upper interval includes numerous bioevents and the LOC is very tightly constrained. The age of the 'Vraconnian Stage' spans from 98.26 to 97.13 Ma. The black shale, organic-rich BREISTROFFER

marker beds were deposited at the beginning of the 'Vraconnian'.

## Integrated biostratigraphic ranges

The stratigraphic ranges of 46 ammonites that were recorded in the seven key sections of AMÉDRO (2008) were integrated into a single range chart at the scale of the thickness of the Mont Risou section (Fig. 5). This scale was converted to a numerical age scale by graphing the composited VRACCS.1 data set to the MIDK45CS.1 data set as explained above. The three Middle Albian Substage zones are defined by the FO of the nominate species (Fig. 1; Table 2). The base of the Upper Albian Substage is defined by the FO of Dipoloceras cristatum, which is the basal subzone of the Inflatum Zone. Two of the next overlying subzones are defined in this dataset by the FOs of Hysteroceras orbignyi and Callihoplites auritus; Hysteroceras varicosum is not included in this dataset. The base of Stoliczkaia dispar defines the base of the uppermost Upper Albian Dispar Zone.



**Figure 5:** Chronostratigraphic range chart of ammonites in 'Vraconnian' composited database of key 'Vraconnian' sections. Ages interpolated by graphic correlation of the VRACCS.1 database with the MIDK45CS.1 database. The ages of some ranges are younger in the subset of 'Vraconnian' sections than in the complete set of sections in the MIDK45CS database used in Figure 7.

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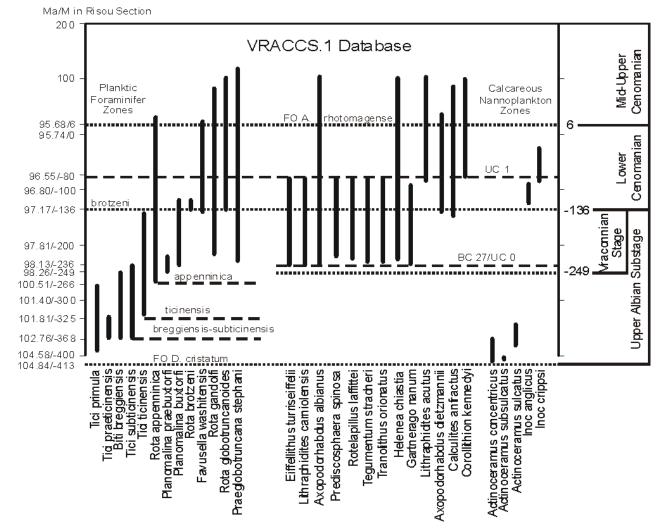
AXAT		FO - LO	MIDK45C		Lepthoplites cantabrigiensis	-194.7543	-194.7543	97.75*	97.75*
Acanthoceras amphibolum	65.0472	65.0472	94.3454	92.6212	Lepthoplites falcoides	-248.88	-180.3551	98.58*	98.31*
Acanthoceras rhotomagense	5.9825	43.151	94.9483	92.5959	Lepthoplites pseudoplanus	-248.88	-234.88	98.31*	98.16*
Actinoceramus subsulcatus	-406.00	-406.00	104.79*	104.79*	Lithraphidites acutus	-90.8027	101.6637	96.3969	92.7
Actinoceramus sulcatus	-381.00	-329.0148 -93.7467	104.4776	101.5134	Lithraphidites alatus	-139.916	-105.5228	98.296 134.1294	93.2
Algericeras boghariense	ericeras boghariense -103.4988 -93.746 Igericeras proratum -92.6427 -64.674		96.5874	96.2374	Lithraphidites carniolensis Lithraphidites pseudoquadratus	-236.00	-80.00		65.4901
Amphizygus brooksii			96.4245	95.578		-236.00 -475.7512	21.0707 -475.7512	98.1749 107.84	93.87 107.5987
Anahoplites daviesi	-236.00 -414.8517	-80.00 -410.6029	124.717 105.1156	65.505 104.8296	Lyelliceras lyelli Manivitella pemmatoidea	-236.00	-475.7512	133.9695	65.2514
Anahoplites intermedius	-465.8373	-450.2584	107.1613	104.0290	Mantelliceras dixoni	-41.4901	-41.49	95.6585	95.4
Anisoceras perarmatum	-353.00	-180.0123	98.426	97.5888	Mantelliceras mantelli	-132.00	-38.00	97.0656	95.65
Anisoceras picteti	-248.88	-247.2	94.8091	94.3577	Mantelliceras saxbii	-127.8239	-54.0022	96.9643	95.5
Anisoceras pseudoelegans	-188.2678	-188.2678	97.68*	97.68*	Mariella bergeri	-280.00	-129.6378	98.6353	96.8887
Anisoceras salei	-353.00	-353.00	102.7656	102.7656	Mariella cenomanensis	-127.8239	-112.3952	96.9524	95.7203
Arrhaphoceras briacensis	-136.00	-132.00	97.0865	97.0865	Mariella gresslyi	-276.00	-276.00	98.59*	98.59*
Arrhaphoceras substuderi	-236.8768	-180.3551	98.18*	97.6*	Markalius circumradiatus	-228.00	-80.00	134.0985	82.2933
Axopodorhabdus albianus	-236.00	102.7677	109.77	90.6992	Marker bed Breistroffer	-235.00	-224.00	98.1644	98.0493
Axopodorhabdus dietzmannii	-139.916	35.7909	128.6386	82.56	Mojsisovicsia subdelaruei	-436.8038	-436.8038	105.8965	105.8965
Beudanticeras beudanti	-410.6029	-321.1158	104.9638	103.0425	Mortoniceras alstonensis	-248.88	-247.2	98.31*	98.29*
Biticinella breggiensis	-367.6759	-250.0185	105.757	97.5059	Mortoniceras fallax	-248.88	-180.00	98.31*	97.58*
Calculites anfractus	-140.00	-84.00	97.1702	96.5842	Mortoniceras inflatum	-321.1158	-241.59	103.0425	99.1149
Callihoplites auritus	-321,1924	-269.043	103.0146	100.4255	Mortoniceras perinflatum	-280.00	-226.00	98.6353	98.0702
Callihoplites cantabrigense	-280.00	-230.00	98.6353	98.1121	Mortoniceras pricei	-342.7298	-318.414	104.1574	102.1977
Callihoplites leptus	-241.587	***	98.23*	***	Neolobites vibrayeanus	101.6637	102.7677	93.7514	93.12
Callihoplites pulcher	-170.00	-170.00	97.49*	97.49*	Neophlycticeras blancheti	-248.88	-180.00	98.31*	97.58*
Callihoplites seeleyi	-236.00	-170.00	98.17*	97.49*	Neostlingoceras carcitanense	-132.00	-38.00	97.0656	96.1028
Callihoplites tetragonus	-236.8768	-180.00	98.18*	97.60*	Ostlingoceras puzosianum	-236.00	-129.6378	98.17*	96.97*
Callihoplites vraconensis	-248.88	-180.0123	97.49*	97.60*	Oxytropidoceras roissyanum	-472.9187	-472.9187	108.0147	107.58
Cantabrigites subsimplex	-170.00	-170.00	97.49*	97.49*	Percivalia hauxtonensis	-144.00	-144.00	97.2121	93.47
Carbon peak OAE 2	100.9276	104.9757	93.52	93.45	Placozygus fibuliformis	-230.00	-80.00	98.1121	65,505
Chiastozygus bifarius	-236.00	-84.00	98.1749	65.505	Planomalina buxtorfi	-236.00	-119.00	100.606	96.0093
Chiastozygus litterarius	-236.00	-80.00	128.2573	65.5535	Planomalina praebuxtorfi	-250.0185	-216.0556	100.7341	97.9467
Chiastozygus platyrhethus	-236.00	-80.00	125.5054	88.3575	Pleurohoplites renauxianus	-236.8768	-180.3551	98.18*	97.60*
Corollithion kennedyi	-80.00	101.6637	96.55	92.00	Pleurohoplites subvarians	-180.0123	-180.0123	97.59*	97.59*
Corollithion madagaskarensis	-236.00	-80.00	122.358	65.3262	Praeglobotruncana delrioensis	-222.9565	101.6637	108.0343	92.00
Corollithion signum	-236.00	-80.00	114.0455	70.4437	Praeglobotruncana stephani	-235.7826	118.2239	100.509	90.41
Cretarhabdus conicus Cretarhabdus striatus	-236.00	-80.00 -80.00	133.1464 117.1136	64.5992 65.505	Prediscosphaera columnata Prediscosphaera cretacea	-236.00 -84.00	-80.00	122.8533 119.3508	90.7 64.523
Cretarnabuus striatus Cribrosphaerella ehrenbergii	-236.00 -236.00	-80.00	117.1138	94.3685	Prediscosphaera spinosa	-220.00	-80.00	121.9656	64.4953
Dicarinella algeriana	38.73	118.2239	95.105	89.7362	Pseudaspidoceras flexuosum	109.7598	109.7598	93.044	93.00
Dicarinella hagni	80.3194	118.2239	93.8363	89.1675	Quadrum gartneri	107.1837	128.16	93.5451	68.3833
Dimorphoplites niobe	-449,5502		106.3502	105.8965		-236.00	-80.00	124,6741	92.00
Dimorphoplites niobe Dipoloceras cristatum	-449.5502 -413.00	-436.8038	106.3502 105.5386	105.8965 104.1574	Rhagodiscus achlyostaurion	-236.00 -236.00	-80.00 -80.00	124.6741 123.278	92.00 65.505
Dipoloceras cristatum	-413.00	-436.8038 -406.00	105.5386	104.1574	Rhagodiscus achlyostaurion Rhagodiscus angustus	-236.00	-80.00	123.278	65.505
	-413.00 -236.00	-436.8038			Rhagodiscus achlyostaurion				
Dipoloceras cristatum Discorhabdus ignotus	-413.00	-436.8038 -406.00 -80.00	105.5386 128.6386	104.1574 65.505	Rhagodiscus achlyostaurion Rhagodiscus angustus Rhagodiscus asper	-236.00 -236.00	-80.00 -80.00	123.278 128.6386	65.505 92.95
Dipoloceras cristatum Discorhabdus ignotus Eiffellithus turriseiffelii	-413.00 -236.00 -236.00	-436.8038 -406.00 -80.00 -80.00	105.5386 128.6386 101.856	104.1574 65.505 64.4399	Rhagodiscus achlyostaurion Rhagodiscus angustus Rhagodiscus asper Rhagodiscus splendens	-236.00 -236.00 -228.00	-80.00 -80.00 -80.00	123.278 128.6386 123.278	65.505 92.95 65.551
Dipoloceras cristatum Discorhabdus ignotus Eiffellithus turriseiffelii Ellipsagelosphaera ovata	-413.00 -236.00 -236.00 -216.00	-436.8038 -406.00 -80.00 -80.00 -112.00	105.5386 128.6386 101.856 121.959	104.1574 65.505 64.4399 88.1021	Rhagodiscus achlyostaurion Rhagodiscus angustus Rhagodiscus asper Rhagodiscus splendens Rotalipora appenninica	-236.00 -236.00 -228.00 -265.787	-80.00 -80.00 -80.00 23.6467	123.278 128.6386 123.278 100.5159	65.505 92.95 65.551 94.48
Dipoloceras cristatum Discorhabdus ignotus Eiffellithus turriseiffelii Ellipsagelosphaera ovata Eprolithus apertior	-413.00 -236.00 -236.00 -216.00 -236.00	-436.8038 -406.00 -80.00 -80.00 -112.00 -80.00	105.5386 128.6386 101.856 121.959 121.1235	104.1574 65.505 64.4399 88.1021 96.5423	Rhagodiscus achlyostaurion Rhagodiscus angustus Rhagodiscus asper Rhagodiscus splendens Rotalipora appenninica Rotalipora brotzeni	-236.00 -236.00 -228.00 -265.787 -136.00	-80.00 -80.00 -80.00 23.6467 -119.00	123.278 128.6386 123.278 100.5159 97.0842	65.505 92.95 65.551 94.48 94.62
Dipoloceras cristatum Discorhabdus ignotus Eiffellithus turriseiffelii Ellipsagelosphaera ovata Eprolithus apertior Eprolithus floralis	-413.00 -236.00 -236.00 -216.00 -236.00 -236.00	-436.8038 -406.00 -80.00 -80.00 -112.00 -80.00 -84.00	105.5386 128.6386 101.856 121.959 121.1235 122.8468	104.1574 65.505 64.4399 88.1021 96.5423 85.5995	Rhagodiscus achlyostaurion Rhagodiscus angustus Rhagodiscus asper Rhagodiscus splendens Rotalipora appenninica Rotalipora brotzeni Rotalipora cushmani	-236.00 -236.00 -228.00 -265.787 -136.00 33.9508	-80.00 -80.00 -80.00 23.6467 -119.00 101.6637	123.278 128.6386 123.278 100.5159 97.0842 96.17	65.505 92.95 65.551 94.48 94.62 93.07
Dipoloceras cristatum Discorhabdus ignotus Eiffellifukus turriseiffelii Ellipsagelosphaera ovata Eprolithus apertior Eprolithus floralis Euhoplites lautus	-413.00 -236.00 -236.00 -216.00 -236.00 -236.00 -433.9713	-436.8038 -406.00 -80.00 -80.00 -112.00 -80.00 -84.00 -84.00	105.5386 128.6386 101.856 121.959 121.1235 122.8468 105.9188	104.1574 65.505 64.4399 88.1021 96.5423 85.5995 104.6453	Rhagodiscus achlyostaurion Rhagodiscus angustus Rhagodiscus asper Rhagodiscus splendens Rotalipora appenninica Rotalipora brotzeni Rotalipora deckei	-236.00 -236.00 -228.00 -265.787 -136.00 33.9508 23.6467	-80.00 -80.00 -80.00 23.6467 -119.00 101.6637 37.9989	123.278 128.6386 123.278 100.5159 97.0842 96.17 95.3597	65.505 92.95 65.551 94.48 94.62 93.07 93.2
Dipoloceras cristatum Discorhabdus ignotus Eiffellithus turriseiffelii Ellipsagelosphaera ovata Eprolithus apertior Eprolithus floralis Euhopites lautus Euhopites loriatus Euhopites loriatus Euhopites loriatus	-413.00 -236.00 -236.00 -236.00 -236.00 -433.9713 -465.8373 -103.4988 108.6557	-436.8038 -406.00 -80.00 -80.00 -112.00 -84.00 -84.00 -410.6 -436.8038 -19.04 108.6557	105.5386 128.6386 101.856 121.959 121.1235 122.8468 105.9188 106.9309 96.5874 93.88	104.1574 65.505 64.4399 88.1021 96.5423 85.5995 104.6453 105.8965 94.5395 93.15	Rhagodiscus achlyostaurion Rhagodiscus angustus Rhagodiscus asper Rhagodiscus splendens Rotalipora appenninica Rotalipora brotzeni Rotalipora cushmani Rotalipora deeckei Rotalipora evoluta	-236.00 -236.00 -228.00 -265.787 -136.00 33.9508 23.6467 -139.916 -222.9565 -136.00	-80.00 -80.00 23.6467 -119.00 101.6637 37.9989 -52.1622 88.7835 101.6637	123.278 128.6386 123.278 100.5159 97.0842 96.17 95.3597 97.588 98.9078 97.13	65.505 92.95 65.551 94.48 94.62 93.07 93.2 95.05 93.52 93.15
Dipoloceras cristatum Discorhabdus ignotus Eiffellithus turriseiffelii Ellipsagelosphaera ovata Eprolithus apertior Eprolithus floralis Euhoplites lautus Euhoplites loricatus Euhoplites loricatus	-413.00 -236.00 -236.00 -216.00 -236.00 -236.00 -433.9713 -465.8373 -103.4988	-436.8038 -406.00 -80.00 -80.00 -112.00 -84.00 -84.00 -410.6 -436.8038 -19.04	105.5386 128.6386 101.856 121.959 121.1235 122.8468 105.9188 106.9309 96.5874	104.1574 65.505 64.4399 88.1021 96.5423 85.5995 104.6453 105.8965 94.5395	Rhagodiscus achlyostaurion           Rhagodiscus angustus           Rhagodiscus asper           Rhagodiscus splendens           Rotalipora appenninica           Rotalipora cushmani           Rotalipora deeckei           Rotalipora deeckei           Rotalipora deeckei           Rotalipora deeckei           Rotalipora deeckei	-236.00 -236.00 -228.00 -265.787 -136.00 33.9508 23.6467 -139.916 -222.9565	-80.00 -80.00 23.6467 -119.00 101.6637 37.9989 -52.1622 88.7835	123.278 128.6386 123.278 100.5159 97.0842 96.17 95.3597 97.588 98.9078	65.505 92.95 65.551 94.48 94.62 93.07 93.2 95.05 93.52
Dipoloceras cristatum Discorhabdus ignotus Eiffellithus turriseiffelii Ellipsagelosphaera ovata Eprolithus apertior Eprolithus floralis Euhopites lautus Euhopites loriatus Euhopites loriatus Euhopites loriatus	-413.00 -236.00 -236.00 -236.00 -236.00 -433.9713 -465.8373 -103.4988 108.6557	-436.8038 -406.00 -80.00 -80.00 -112.00 -84.00 -84.00 -410.6 -436.8038 -19.04 108.6557	105.5386 128.6386 101.856 121.959 121.1235 122.8468 105.9188 106.9309 96.5874 93.88	104.1574 65.505 64.4399 88.1021 96.5423 85.5995 104.6453 105.8965 94.5395 93.15	Rhagodiscus achlyostaurion           Rhagodiscus angustus           Rhagodiscus asper           Rhagodiscus splendens           Rotalipora appenninica           Rotalipora brotzeni           Rotalipora deeckei           Rotalipora deeckei           Rotalipora deeckei           Rotalipora gandolfi           Rotalipora gandolfi	-236.00 -236.00 -228.00 -265.787 -136.00 33.9508 23.6467 -139.916 -222.9565 -136.00	-80.00 -80.00 23.6467 -119.00 101.6637 37.9989 -52.1622 88.7835 101.6637 99.8236 101.6637	123.278 128.6386 123.278 100.5159 97.0842 96.17 95.3597 97.588 98.9078 97.13	65.505 92.95 65.551 94.48 94.62 93.07 93.2 95.05 93.52 93.15
Dipoloceras cristatum Discorhabdus ignotus Eiffellithus turriseiffelii Ellipsagelosphaera ovata Eprolithus apertior Eprolithus floralis Euhoplites lautus Euhoplites loricatus Euhystrichoceras nicaisei Euomphaloceras septemseriatum Favusella washitensis Forbesiceras beaumontianum Gartnerago nanum	-413.00 -236.00 -236.00 -236.00 -236.00 -433.9713 -465.8373 -465.8373 -103.4988 108.6557 -139.916 -127.8239 -236.00	-436.8038 -406.00 -80.00 -112.00 -80.00 -84.00 -410.6 -436.8038 -19.04 108.6557 11.8706 -128.8911 -96.00	105.5386 128.6386 101.856 121.959 121.1235 122.8468 105.9188 106.9309 96.5874 93.88 114.1975 96.9524 98.296	104.1574 65.505 64.4399 88.1021 96.5423 85.5995 104.6453 105.8965 94.5395 93.15 94.84 94.84 94.84 94.23	Rhagodiscus achlyostaurion           Rhagodiscus angustus           Rhagodiscus asper           Rhagodiscus splendens           Rotalipora appenninica           Rotalipora brotzeni           Rotalipora brotzeni           Rotalipora brotzeni           Rotalipora desckei           Rotalipora evoluta           Rotalipora gadolfi           Rotalipora gilobotruncanoides           Rotalipora greenhornensis           Rotalipora reicheli	-236.00 -236.00 -228.00 -265.787 -136.00 33.9508 23.6467 -139.916 -222.9565 -136.00 -100.0028 -59.5223 -1.0096	-80.00 -80.00 23.6467 -119.00 101.6637 37.9989 -52.1622 88.7835 101.6637 99.8236 101.6637 32.1108	123.278 128.6386 123.278 100.5159 97.0842 96.17 95.3597 97.588 98.9078 97.13 97.0842 97.384 96.706	65.505 92.95 65.551 94.48 94.62 93.07 93.2 95.05 93.25 93.15 93.07 93.15 93.15
Dipoloceras cristatum Discorhabdus ignotus Eiffellithus turriseiffelii Ellipsagelosphaera ovata Eprolithus apertior Eprolithus floralis Euhoplites lautus Euhoplites loricatus Euhystrichoceras nicaisei Euomphaloceras septemseriatum Favusella washitensis Forbesiceras beaumontianum Gartnerago nanum	-413.00 -236.00 -236.00 -236.00 -236.00 -433.9713 -465.8373 -103.4988 108.6557 -139.916 -127.8239 -236.00 107.1837	-436.8038 -406.00 -80.00 -112.00 -80.00 -410.6 -43.00 -44.00 -44.06 -436.8038 -19.04 108.6557 11.8706 -128.8911 -96.00 128.16	105.5386 128.6386 101.856 121.959 121.1235 122.8468 105.9188 106.9309 96.5874 93.88 114.1975 96.9524 98.296 99.2536	104.1574 65.505 64.4399 88.1021 96.5423 85.5995 104.6453 105.8965 94.5395 93.15 94.84 96.2621 94.23 64.743	Rhagodiscus achlyostaurion         Rhagodiscus angustus         Rhagodiscus asper         Rhagodiscus splendens         Rotalipora appenninica         Rotalipora cushmani         Rotalipora cushmani         Rotalipora deeckei         Rotalipora agolotruncanoides         Rotalipora globotruncanoides         Rotalipora greenhornensis         Rotalipora reicheli         Rotalipora reicheli	-236.00 -236.00 -228.00 -265.787 -136.00 33.9508 23.6467 -139.916 -222.9565 -136.00 -100.0028 -59.5223 -1.0096 -236.00	-80.00 -80.00 23.6467 -119.00 101.6637 37.9989 -52.1622 88.7835 101.6637 99.8236 101.6637 32.1108 -80.00	123.278 128.6386 123.278 100.5159 97.0842 96.17 95.3597 97.588 98.9078 97.13 97.0842 97.384 96.706 124.612	65.505 92.95 65.551 94.48 94.62 93.07 93.2 93.25 93.52 93.52 93.15 93.07 93.15 94.42 65.597
Dipoloceras cristatum Discorhabdus ignotus Eiffellithus turriseiffelii Ellipsagelosphaera ovata Eprolithus apertior Eprolithus floralis Euhoplites lautus Euhoplites lautus Euhoplites loricatus Euhystrichoceras nicaisei Euomphaloceras septemseriatum Favusella washitensis Forbesiceras beaumontianum Gartnerago nanum Gartnerago paeobliquum	-413.00 -236.00 -236.00 -236.00 -236.00 -433.9713 -465.8373 -103.4988 108.6557 -139.916 -127.8239 -236.00 107.1837 -84.00	-436.8038 -406.00 -80.00 -112.00 -412.00 -44.00 -436.8038 -436.8038 -19.04 108.6557 11.8706 -128.811 -96.00 128.16 128.16	105.5386 128.6386 101.856 121.959 121.1235 122.8468 105.9188 105.9188 105.9188 106.9309 96.5874 93.88 114.1975 96.9524 98.296 98.296 98.296	104.1574 65.505 64.4399 88.1021 96.5423 85.5995 104.6453 105.8965 94.5395 93.15 94.84 96.2621 94.23 64.743 ***	Rhagodiscus achlyostaurion         Rhagodiscus angustus         Rhagodiscus asper         Rhagodiscus splendens         Rotalipora appenninica         Rotalipora cushmani         Rotalipora cushmani         Rotalipora deeckei         Rotalipora gandolfi         Rotalipora golobtruncanoides         Rotalipora greenhormensis         Rotalipora montsalvensis         Rotalipora reicheli         Rotalipora reicheli	-236.00 -236.00 -265.787 -136.00 33.9508 23.6467 -139.916 -222.9565 -136.00 -100.0028 -59.5223 -1.0006 -236.00 -224.00	-80.00 -80.00 -80.00 23.6467 -119.00 101.6637 37.9989 -52.1622 88.7835 101.6637 99.8236 101.6637 32.1108 -80.00	123.278 128.6386 123.278 100.5159 97.0842 96.17 95.3597 95.3597 97.588 98.9078 97.13 97.0842 97.384 96.706 124.612 134.0402	655.505           92.95           65.551           94.48           94.62           93.07           93.2           95.05           93.52           93.15           93.15           94.42           65.597           66.407
Dipoloceras cristatum Discorhabdus ignotus Eiffellithus turriseiffelii Ellipsagelosphaera ovata Eprolithus apertior Eprolithus floralis Euhoplites lautus Euhoplites loricatus Euhoplites loricatus Euhystrichoceras septemseriatum Favusella washitensis Forbesiceras beaumontianum Gartnerago obliquum Gartnerago obliquum	-413.00 -236.00 -236.00 -236.00 -336.00 -336.00 -433.9713 -465.8373 -103.4988 108.6557 -139.916 -127.8239 -236.00 107.1837 -64.00 -139.916	-436.8038 -406.00 -80.00 -80.00 -412.00 -440.6 -436.8038 -436.8038 -13.84 108.6557 11.8706 -128.8911 -96.00 128.16 -28.8911 -8.8911 -9.8911 -9.891 -	105.5386 128.6386 101.856 121.959 121.125 122.8468 105.9188 106.9309 96.5874 93.88 114.1975 96.5924 98.296 99.2556 96.5842 97.588	104.1574 65.505 64.4399 88.1021 96.5423 85.5995 104.6453 105.0965 94.5395 94.5395 94.84 96.2621 94.23 64.743 *** 96.864	Rhagodiscus achlyostaurion           Rhagodiscus angustus           Rhagodiscus asper           Rhagodiscus asper           Rotalipora plendens           Rotalipora brotzeni           Rotalipora deckei           Rotalipora gendolfi           Rotalipora greenhornensis           Rotalipora montsalvensis           Rotalipora reicheli           Rotalipora reicheli           Rotalipora reicheli           Rotalipora singustatus           Rotalipora singustatus	-236.00 -268.00 -268.787 -136.00 33.9508 23.6467 -139.016 -222.9565 -139.0028 -59.5223 -1.00.0028 -226.000 -226.000 -224.000 -127.3889	-80.00 -80.00 -80.00 23.6467 -119.00 101.6637 37.9989 -52.1622 88.7835 101.6637 99.8236 101.6637 32.1108 -80.00 -80.00	123.278 128.6386 123.278 100.5159 97.0842 96.17 95.3597 97.588 98.9078 97.13 97.0842 97.13 97.0842 97.344 96.706 124.612 134.0402 97.51*	65.505 92.95 65.551 94.48 94.62 93.07 93.2 95.05 93.52 93.15 93.07 93.15 93.07 93.15 94.42 65.597 66.407 ***
Dipoloceras cristatum Discorhabdus ignotus Eiffellithus turriseiffelii Ellipsagelosphaera ovata Eprolithus apertior Eprolithus floralis Euhopites lautus Euhopites loricatus Euhystrichoceras nicaisei Euomphaloceras septemseriatum Favusella washitensis Forbesiceras beaumontianum Gartnerago nanum Gartnerago obliquum Gartnerago stenostauron Gartnerago stenostauron	-413.00 -236.00 -236.00 -236.00 -236.00 -433.9713 -465.8373 -103.4988 108.6557 -139.916 -127.8239 -236.00 107.1837 -64.00 -139.916 -108.00	-436.8038 -406.00 -80.00 -112.00 -4112.00 -436.8038 -19.04 -436.8038 -19.04 -436.8038 -19.04 -436.8038 -45	105.5386 128.6386 101.856 121.959 122.8468 105.9188 106.9309 96.5874 93.88 114.1975 96.9524 98.296 96.5842 96.5842 97.588 96.8353	104.1574 65.505 64.4399 88.1021 96.5423 85.5995 104.6453 105.8965 94.5395 93.15 94.84 96.2621 94.23 64.743 *** 96.664 89.0722	Rhagodiscus achlyostaurion           Rhagodiscus angustus           Rhagodiscus asper           Rhagodiscus splendens           Rotalipora appenninica           Rotalipora brotzeni           Rotalipora brotzeni           Rotalipora brotzeni           Rotalipora deckei           Rotalipora gendulti           Rotalipora greenhormensis           Rotalipora montsalvensis           Rotalipora reicheli           Rotelapillus cenulatus           Rotelapillus laffittei           Scaphites simplex           Schloenbachia varians	-236.00 -265.787 -265.787 -136.00 33.9508 23.6467 -139.916 -222.9665 -136.00 -100.0028 -59.5223 -1.0096 -236.00 -224.00 -172.3889 -119.9188	-80.00 -80.00 -80.00 23.6467 -119.00 101.6637 37.9989 -52.1622 88.7835 101.6637 99.8236 101.6637 32.1108 -80.00 -80.00	123.278 128.6386 123.278 100.5159 97.0842 96.17 95.3597 97.588 98.0078 97.13 97.0842 97.384 96.706 124.612 134.0402 134.0402 97.51* 97.0648	65.505 92.95 65.551 94.48 93.07 93.2 93.2 93.52 93.15 93.07 93.15 93.15 93.42 65.597 66.407 *** ***
Dipoloceras cristatum Discorhabdus ignotus Eiffellithus turriseiffelii Ellipsagelosphaera ovata Eprolithus apertior Eprolithus floralis Euhoplites lautus Euhoplites loricatus Euhystrichoceras nicaisei Euomphaloceras septemseriatum Favusella washitensis Forbesiceras beaumontianum Gartnerago nanum Gartnerago obliquum Gartnerago paeobliquum Gartnerago stenostauron Gartnerago theta Gartnerago theta	-413.00 -236.00 -236.00 -236.00 -433.9713 -465.8373 -103.4988 108.6557 -139.916 -127.8239 -236.00 107.1837 -84.00 -139.916 -108.00 -127.82	-436.8038 -406.00 -80.00 -112.00 -436.00 -440.6 -436.8038 -19.6 -436.8038 -19.6 -128.8911 -96.00 128.16 -128.3911 -128	105.5386 128.6386 101.856 121.959 121.1235 122.2468 105.9188 106.9309 96.5874 93.88 114.1975 96.9524 98.296 99.2536 96.5842 97.588 96.8353 96.95*	104.1574 65.505 64.4399 88.1021 96.5423 85.5995 104.6453 105.8965 94.5395 93.15 94.84 96.2621 94.23 64.743 *** 96.864 89.0722 96.94*	Rhagodiscus achlyostaurion           Rhagodiscus angustus           Rhagodiscus asper           Rhagodiscus splendens           Rotalipora appenninica           Rotalipora brotzeni           Rotalipora brotzeni           Rotalipora brotzeni           Rotalipora deeckei           Rotalipora evoluta           Rotalipora gandolfi           Rotalipora golobtruncanoides           Rotalipora greenhornensis           Rotalipora montsalvensis           Rotalipora reicheli           Rotalipora serolutus           Rotalipora brotzenis           Rotalipora genotype           Rotalipora genotype           Rotalipora genotype           Rotalipora genotype           Rotalipora genotype           Rotalipora seventus           Rotalipora genotype           Rotalipora seventus           Rotalipora montsalvensis           Rotalipora seventus           Rotalipora seventus           Rotalipora seventus           Rotalipora seventus           Rotalipora montsalvensis           Rotalipora seventus           Rotalipora seventus           Rotalipora seventus           Rotalipora seventus           Rotalipora seventus <td>-236.00 -265.787 -265.787 -136.00 33.9508 23.6467 -139.916 -222.9655 -136.00 -136.00 -259.5223 -1.0096 -236.00 -224.00 -172.3889 -119.9188 -132.00</td> <td>-80,00 -80,00 -80,00 23,6467 -119,00 101,6637 37,9989 -52,1622 88,7835 101,6637 99,8236 101,6637 32,1108 -80,00 -80,00 -80,00 -80,00</td> <td>123.278 128.6386 123.278 100.5159 97.0842 96.17 95.3597 97.588 98.9078 97.588 97.0842 97.0842 97.384 96.706 124.612 134.0402 97.51*</td> <td>655.505           92.95           65.551           94.48           94.62           93.07           93.2           95.05           93.52           93.15           93.42           65.597           66.407           ***           95.12           96.2284</td>	-236.00 -265.787 -265.787 -136.00 33.9508 23.6467 -139.916 -222.9655 -136.00 -136.00 -259.5223 -1.0096 -236.00 -224.00 -172.3889 -119.9188 -132.00	-80,00 -80,00 -80,00 23,6467 -119,00 101,6637 37,9989 -52,1622 88,7835 101,6637 99,8236 101,6637 32,1108 -80,00 -80,00 -80,00 -80,00	123.278 128.6386 123.278 100.5159 97.0842 96.17 95.3597 97.588 98.9078 97.588 97.0842 97.0842 97.384 96.706 124.612 134.0402 97.51*	655.505           92.95           65.551           94.48           94.62           93.07           93.2           95.05           93.52           93.15           93.42           65.597           66.407           ***           95.12           96.2284
Dipoloceras cristatum Discorhabdus ignotus Eiffellithus turriseiffelii Ellipsagelosphaera ovata Eprolithus apertior Eprolithus apertior Euhoplites lautus Euhoplites loricatus Euhystrichoceras nicaisei Euomphaloceras septemseriatum Farvusella washitensis Forbesiceras beaumontianum Gartnerago nanum Gartnerago obliquum Gartnerago stenostauron Gartnerago stenostauron Gartnerago theta Graysonites azregensis	-413.00 -236.00 -236.00 -236.00 -236.00 -433.9713 -465.8373 -103.4988 108.6557 -139.916 -127.8239 -236.00 107.1837 -84.00 -139.916 -108.00 -127.82 -126.0738	-436.8038 -406.00 -80.00 -112.00 -410.60 -436.8038 -19.04 108.657 11.8706 -128.8011 -96.00 128.16 -128.3911 -128.391 -128.391 -128.391 -127.2379	105.5386 128.6386 101.856 121.959 121.1235 122.8468 105.9188 106.9309 96.5874 96.9524 96.9524 99.2536 99.2536 99.2536 96.6353 96.95* 96.92*	104.1574 65.505 64.4399 88.1021 96.5423 85.5995 104.6453 105.8965 94.5395 94.5395 94.84 96.2621 94.23 64.743 *** 96.864 89.0722 96.87*	Rhagodiscus achlyostaurion           Rhagodiscus angustus           Rhagodiscus asper           Rhagodiscus splendens           Rotalipora appenninica           Rotalipora brotzeni           Rotalipora brotzeni           Rotalipora cushmani           Rotalipora evoluta           Rotalipora gandolfi           Rotalipora gandolfi           Rotalipora genenninica           Rotalipora evoluta           Rotalipora genenhormensis           Rotalipora montsalvensis           Rotalipora montsalvensis           Rotalipora brotzeni           Schlephachita simplex           Schleenbachia varians           Sciponoceras roto	-236.00 -265.787 -265.787 -136.00 23.6467 -139.916 -222.9565 -136.00 -100.0028 -59.5223 -1.0096 -236.00 -224.00 -172.3889 -119.9188 -132.00 -76.0825	-80.00 -80.00 -80.00 23.647 -119.00 101.6637 37.9989 -52.1622 88.7835 101.6637 99.8236 101.6637 32.1108 -80.00 -80.00 *** -38.00 -30.00 -42.2261	123.278 128.6386 123.278 100.5159 97.0842 96.17 95.3597 97.588 98.9078 97.13 97.0842 97.0842 97.0842 97.0842 134.0402 97.51* 97.0648 97.0656 96.8389	655.505           92.95           65.551           94.48           94.62           93.07           93.2           95.05           93.2           95.05           93.21           93.52           93.15           93.07           93.15           94.42           65.597           66.407           95.12           96.2284           95.45
Dipoloceras cristatum Discorhabdus ignotus Eiffellithus turriseiffelii Ellipsagelosphaera ovata Eprolithus apertior Eprolithus apertior Euhoplites lautus Euhoplites lautus Euhoplites loricatus Euhystrichoceras nicaisei Euomphaloceras septemseriatum Favusella washitensis Forbesiceras beaumontianum Gartnerago nanum Gartnerago obliquum Gartnerago obliquum Gartnerago benostauron Gartnerago theta Graysonites azregensis Graysonites cobbani Hamites virgulatus	-413.00 -236.00 -236.00 -236.00 -433.9713 -465.8373 -103.4988 108.6557 -139.916 -127.829 -236.00 107.1837 -84.00 -139.916 -108.00 -127.82 -126.0738 -126.0738	-436.8038 -406.00 -80.00 -112.00 -436.03 -436.038 -436.038 -19.04 108.6557 11.8706 -128.10 128.16 *** -128.391 -80.00 -127.2379 -122.2903 -122.2905	105.5386 128.6386 101.856 121.959 121.1235 122.8468 105.9188 106.9309 96.5874 96.5874 96.9524 96.9524 96.5824 97.588 96.5842 97.588 96.953	104.1574 65.505 64.4399 88.1021 96.5423 85.5995 104.6453 105.8965 94.5395 94.5395 94.84 96.2621 94.23 64.743 *** 96.864 89.0722 96.94* 96.87*	Rhagodiscus achlyostaurion           Rhagodiscus angustus           Rhagodiscus asper           Rhagodiscus asper           Rotalipora appenninica           Rotalipora brotzeni           Rotalipora deckei           Rotalipora gandoffi           Rotalipora gandoffi           Rotalipora gandoffi           Rotalipora greenhornensis           Rotalipora greenhornensis           Rotalipora rontsalvensis           Rotalipora rontsalvensis           Rotalipora singles rescheli           Rotalipora rontsalvensis           Rotalipora rontsalvensis           Rotalapilus crenulatus           Rotelapillus crenulatus           Rotelapillus crenulatus           Sciponoceras roto           Sharpeiceras laticlavicum           Sharpeiceras schlueteri	-236.00 -265.787 -280.00 -265.787 -136.00 33.9508 -222.9505 -136.00 -222.9505 -136.00 -100.0028 -59.5223 -1.0096 -236.00 -224.00 -172.8899 -119.9188 -132.00 -76.0825 -127.8239	-80,00 -80,00 -80,00 23,647 -119,00 101,6637 37,9989 -52,1622 88,7835 101,6637 99,8236 101,6637 32,1108 -80,000 -80,000 -8	123.278 128.6386 123.278 100.5159 97.0842 96.17 95.3597 97.588 98.9078 97.13 97.0842 97.384 96.706 124.612 134.0402 97.51* 97.0656 96.8389 96.6324	655.505           92.95           65.551           94.48           94.62           93.07           93.2           95.05           93.52           93.15           93.07           93.15           93.07           93.15           94.42           65.597           66.407           ***           95.12           96.2284           95.45           96.4478
Dipoloceras cristatum Discorhabdus ignotus Eiffellithus turriseiffelii Ellipsagelosphaera ovata Eprolithus apertior Eprolithus floralis Euhopites lautus Euhopites loricatus Euhopites loricatus Euhystrichoceras nicaisei Euomphaloceras septemseriatum Favusella washitensis Forbesiceras beaumontianum Gartnerago nanum Gartnerago nanum Gartnerago nachum Gartnerago theta Gartnerago theta Graysonites azregensis Graysonites cobbani Hamites virgulatus	-413.00 -236.00 -236.00 -236.00 -336.00 -433.9713 -465.8373 -103.4988 108.6557 -139.916 -127.8239 -236.00 107.1837 -84.00 -139.916 -108.00 -127.82 -126.0738 -126.0738 -126.0738	-436.8038 -406.00 -80.00 -80.00 -412.00 -440.6 -436.8038 -13.84 -19.04 108.6557 11.8706 -128.4801 -86.00 -122.83391 -80.00 -122.2939 -122.2939 -122.2939	105.5386 128.6386 101.856 121.959 121.1235 122.8468 106.9309 96.5874 93.88 114.1975 96.9524 99.2536 99.2536 96.5842 97.588 96.6353 96.6353 96.95* 96.92* 97.71*	104.1574 65.505 64.4399 88.1021 96.5423 85.5995 104.6453 105.0965 93.15 94.84 94.23 64.743 *** 96.864 89.0722 96.864 89.0722 96.87* 96.87* 96.87*	Rhagodiscus achlyostaurion           Rhagodiscus angustus           Rhagodiscus asper           Rhagodiscus asper           Rotalipora appenninica           Rotalipora brotzeni           Rotalipora brotzeni           Rotalipora deckei           Rotalipora gandolfi           Rotalipora gandolfi           Rotalipora genhornensis           Rotalipora greenhornensis           Rotalipora rontralvensis           Rotalipora reicheli           Rotalipora reicheli           Rotalipora simplex           Scaphites simplex           Sciponceras roto           Sharpeiceras schlueteri           Staurolithites glaber	-236.00 -265.787 -268.787 -136.00 33.9508 23.6467 -139.016 -222.9565 -136.00 -100.0028 -59.5223 -1.00.01 -226.00 -172.3889 -139.9188 -132.00 -76.0825 -232.00	-80.00 -80.00 -80.00 23.647 -119.00 101.6637 37.9989 -52.1622 88.783 101.6537 99.8236 101.6537 32.108 -80.00 -80.00 *** -38.00 *** -38.00 -50.00 -50.00 -103.4988 -112.00	123.278 128.6386 123.278 100.5159 97.0842 96.17 97.588 98.9078 97.13 97.0842 97.384 95.706 124.612 134.0402 97.51* 97.0648 97.0656 96.8389 96.9524 98.133	65.505           92.95           65.551           94.48           93.07           93.2           95.05           93.15           93.07           93.15           94.42           65.597           66.407           ***           95.12           96.4478           96.4778
Dipoloceras cristatum Discorhabdus ignotus Eiffellithus turriseiffelii Ellipsagelosphaera ovata Eprolithus apertior Eprolithus floralis Euhopites lautus Euhopites loricatus Euhystrichoceras nicaisei Euomphaloceras septemseriatum Favusella washitensis Forbesiceras beaumontianum Gartnerago nanum Gartnerago nanum Gartnerago obliquum Gartnerago paeobliquum Gartnerago stenostauron Gartnerago stenostauron Gartnerago theta Graysonites azregensis Graysonites cobbani Hamites virgulatus Hayesites albiensis	-413.00 -236.00 -236.00 -236.00 -433.9713 -465.8373 -103.4988 108.6557 -139.916 -127.8239 -236.00 107.1837 -64.00 -139.916 -108.00 -127.82 -126.0738 -11179 -232.00 -236.00	-436.8038 -406.00 -80.00 -80.00 -410.00 -436.030 -436.038 -19.04 -436.038 -19.04 -436.038 -19.04 -19.04 -28.301 -28	105.5386 128.6386 101.856 121.959 122.8468 105.9188 106.9309 96.5874 93.88 114.1975 96.9524 98.296 99.256 96.5825 96.5825 96.583 96.585 96.95* 96.95* 96.97* 118.6477 100.6217	104.1574 65.505 64.4399 88.1021 96.5423 85.5995 104.6453 105.8965 94.5395 94.84 96.2621 94.23 64.743 *** 96.864 89.0722 96.94* 96.87* 97.3296 94.66	Rhagodiscus achlyostaurion           Rhagodiscus angustus           Rhagodiscus asper           Rhagodiscus splendens           Rotalipora appenninica           Rotalipora brotzeni           Rotalipora deckei           Rotalipora gendolfi           Rotalipora godobruncanoides           Rotalipora greenhornensis           Rotalipora greenhornensis           Rotalipora montsalvensis           Rotalipora singusta	-236.00 -265.787 -288.00 -265.787 -136.00 33.9508 23.6467 -139.916 -222.9565 -136.00 -136.00 -236.00 -236.00 -172.3889 -119.9188 -132.00 -76.0825 -127.8239 -232.00 -222.9565	-80,00 -80,00 -80,00 23,647 -119,00 101,6637 37,9989 -52,1622 88,785 101,6637 99,8236 101,6637 32,1108 -80,00 -80,00 -80,00 -80,00 -42,261 -103,4988 -112,00 -112,278	123.278 128.6386 123.278 100.5159 97.0842 96.17 95.3597 97.588 98.0078 97.134 97.0842 97.384 96.706 124.612 134.0402 97.648 97.0656 96.6324 96.6524 96.6323 98.04*	655.505           92.95           65.551           94.48           93.07           93.2           95.05           93.15           93.15           94.42           65.597           66.407           ***           95.12           96.2284           95.45           96.4772           97.00*
Dipoloceras cristatum Discorhabdus ignotus Eiffellifukus turriseiffelii Ellipsagelosphaera ovata Eprolithus apertior Euhopites lautus Euhopites loricatus Euhopites loricatus Euhystrichoceras nicaisei Euomphaloceras septemseriatum Favusella washitensis Forbesiceras beaumontianum Gartnerago nanum Gartnerago paeobliquum Gartnerago paeobliquum Gartnerago stenostauron Gartnerago stenostauron Gartnerago theta Graysonites azregensis Graysonites cobbani Hamites virgulatus Hayesites abliensis Hedbergella libyca Helenea chiastia	-413.00 -236.00 -236.00 -236.00 -433.9713 -465.8373 -103.4988 108.6557 -139.916 -127.8239 -236.00 107.1837 -84.00 -139.916 -108.00 -127.82 -126.0738 -126.0738 -191.1179 -236.00 -236.00 -236.00 -236.00	-436.8038 -406.00 -80.00 -112.00 -436.8030 -436.8038 -19.04 108.6557 11.8706 -128.8010 -128.8010 -128.8010 -127.2379 -122.2003 -165.005 -121.000 102.7677	105.5386 128.6386 101.856 121.959 121.1235 122.4468 105.9188 106.9309 96.5874 93.88 114.1975 96.9524 98.296 99.2546 99.2546 96.8353 96.95* 96.92* 96.92* 100.6277 133.9695	104.1574 65.505 64.4399 88.1021 96.5423 85.5995 104.6453 105.8965 94.34 96.2621 94.23 64.743 *** 96.864 89.0722 96.94* 96.87* 97.3296 94.66 92.7	Rhagodiscus achlyostaurion           Rhagodiscus angustus           Rhagodiscus asper           Rhagodiscus splendens           Rotalipora appenninica           Rotalipora brotzeni           Rotalipora brotzeni           Rotalipora brotzeni           Rotalipora decekei           Rotalipora decekei           Rotalipora gendolfi           Rotalipora gendolfi           Rotalipora gendolfi           Rotalipora greenhormensis           Schloenbachia varians           Schloenbachia varians	-236.00 -265.787 -228.00 -265.787 -136.00 33.9508 23.6467 -136.00 -136.00 -136.00 -136.00 -100.0028 -59.5223 -1.0096 -234.00 -172.3889 -119.9188 -132.00 -76.0825 -127.8239 -232.00 -222.9565 -280.00	-80,00 -80,00 -80,00 23,6467 -119,00 101,6637 37,9989 -52,1622 88,7835 101,6637 99,8236 101,6637 32,1108 -80,000 -80,000 -8	123.278 128.6386 123.278 100.5159 97.0842 96.17 95.3597 97.588 97.13 97.0842 97.0842 97.0842 97.0842 97.514 97.0648 97.0656 98.0339 98.043 98.043	655.505           92.95           65.551           94.48           94.62           93.07           93.2           95.05           93.2           93.07           93.15           94.42           65.597           66.407           ***           95.12           96.2284           95.45           96.472           96.70*           97.0656
Dipoloceras cristatum Discorhabdus ignotus Eiffellithus turriseiffelii Ellipsagelosphaera ovata Eprolithus floralis Euhoplites lautus Euhoplites loricatus Euhystrichoceras nicaisei Euomphaloceras septemseriatum Favusella washitensis Forbesiceras beaumontianum Gartnerago nanum Gartnerago obliquum Gartnerago obliquum Gartnerago stenostauron Gartnerago stenostauron Gartnerago stenostauron Gartnerago theta Graysonites azregensis Graysonites cobbani Hamites virgulatus Hayesites albiensis Hedbergella libyca Helenea chiastia Helicolithus trabeculatus	-413.00 -236.00 -236.00 -236.00 -433.9713 -465.8373 -103.4988 108.6557 -139.916 -127.8239 -236.00 107.1837 -84.00 -139.916 -108.00 -127.82 -126.0738 -191.1179 -232.00 -236.00 -224.00 -236.00	-436.8038 -406.00 -80.00 -112.00 -436.8038 -194.00 -436.8038 -194.00 -138.8057 -128.8011 -28.801 -122.203 -122.203 -165.905 *** -212.00 102.7677 -212.00	105.5386 128.6386 101.856 121.959 121.1235 122.8468 105.9188 106.9309 96.5874 93.88 114.1975 96.9524 98.296 99.2536 96.9524 99.2536 96.95* 96.92* 96.92* 97.71* 118.6477 113.9695 122.8533	104.1574 65.505 64.4399 88.1021 96.5423 105.8965 94.5395 94.5395 94.5395 94.84 96.2621 94.23 64.743 *** 96.864 89.0722 96.94* 96.87* 97.45* 97.45* 97.45* 97.45*	Rhagodiscus achlyostaurion           Rhagodiscus angustus           Rhagodiscus asper           Rhagodiscus splendens           Rotalipora appenninica           Rotalipora brotzeni           Rotalipora brotzeni           Rotalipora brotzeni           Rotalipora decokei           Rotalipora decokei           Rotalipora gandolfi           Rotalipora gobotruncanoides           Rotalipora gobotruncanoides           Rotalipora greenhornensis           Rotalipora montsalvensis           Rotalipora reicheli           Rotalipora simplex           Scaphites simplex           Schloenbachia varians           Sciponoceras roto           Sharpeiceras schlueteri           Staurolithites glaber           Stoliczkaia africana           Stoliczkaia clavigera	-236.00 -265.787 -265.787 -136.00 23.6467 -139.916 -222.9565 -136.00 -224.960 -326.00 -224.00 -100.0028 -39.5223 -1.0096 -226.00 -172.3899 -127.8239 -127.8239 -222.9565 -228.000 -222.9655 -280.00 -280.00	-80,00 -80,00 -23,647 -119,00 101,6637 37,9989 -52,1622 88,7835 101,6637 99,8236 101,6637 32,1108 -80,00 -80,00 -80,00 -80,00 -80,00 -33,00 -42,2261 -103,4988 -112,00 -133,200 -33,00 -34,000 -34,000 -	123.278 128.6386 123.278 100.5159 97.0842 96.17 95.3597 97.588 98.9078 97.134 97.0842 97.0842 97.0842 97.0842 97.0848 97.0648 97.0656 96.8389 96.9524 98.04*3 97.04*3 98.04*3 98.04	655.505           92.95           65.551           94.48           94.62           93.07           93.2           95.05           93.7           93.52           93.15           94.42           65.597           66.407           95.12           96.2284           95.45           96.4478           96.478           96.4672           97.00*           97.0656           97.116
Dipoloceras cristatum Discorhabdus ignotus Eiffellithus turriseiffelii Ellipsagelosphaera ovata Eprolithus apertior Eprolithus apertior Euhoplites lautus Euhoplites loricatus Euhystrichoceras nicaisei Euomphaloceras septemseriatum Favusella washitensis Forbesiceras beaumontianum Gartnerago nanum Gartnerago obliquum Gartnerago stenostauron Gartnerago stenostauron Gartnerago theta Graysonites azregensis Graysonites abbani Hamites virgulatus Hayesites albiensis Hedbergella libyca Helenea chiastia Helicolithus trabeculatus	-413.00 -236.00 -236.00 -236.00 -236.00 -433.9713 -465.8373 -103.4988 108.6557 -139.916 -127.829 -236.00 107.1837 -44.00 -139.916 -108.00 -127.82 -126.0738 -191.1179 -232.00 -236.00	-436.8038 -406.00 -80.00 -112.00 -436.8038 -436.8038 -436.8038 -19.04 108.6557 11.8706 -128.301 -28.301 -28.301 -436.803 -122.2030 -122.205	105.5386 128.6386 101.856 121.959 121.1235 122.8468 105.9188 106.9309 96.5874 96.9524 96.9524 99.2536 96.5842 97.588 96.5842 96.6353 96.55* 96.92* 96.92* 97.71* 118.6477 100.6217 133.9695	104.1574 65.505 64.4399 88.1021 96.5423 105.8965 94.5395 94.5395 94.5395 94.84 96.2621 94.23 64.743 *** 96.864 89.0722 96.87* 97.3296 94.66 92.7 65.505 106.93	Rhagodiscus achlyostaurion           Rhagodiscus angustus           Rhagodiscus asper           Rhagodiscus asper           Rotalipora appenninica           Rotalipora brotzeni           Rotalipora deckei           Rotalipora gandolfi           Rotalipora gandolfi           Rotalipora genhornensis           Rotalipora greenhornensis           Rotalipora montsalvensis           Rotalapora routsalvensis           Rotalapora singlex           Scaphites simplex           Schonbachia varians           Stareiceras laticlavicum           Sharpeiceras laticlavicum           Staliporalitika davigera           Stolicizkaia africana           Stolicizkaia davigera	-236.00 -265.787 -265.787 -136.00 23.6467 -139.916 -222.955 -136.00 -100.0028 -100.0028 -100.0028 -100.0028 -100.0028 -100.0028 -100.0028 -224.000 -224.000 -172.839 -132.000 -222.9555 -228.000 -228.000 -228.000 -228.000 -228.000	-80,00 -80,00 -23,6467 -119,00 101,6637 37,9989 -52,1622 88,7835 101,6637 32,1108 -80,00 -80,00 -40,00 -42,2261 -103,4988 -112,00 -131,278 -132,00 -38,00 -338	123.278 128.6386 123.278 100.5159 97.0842 96.17 95.3597 97.588 98.9078 97.13 97.042 97.044 96.706 124.612 134.0402 97.51* 97.0648 97.0656 96.8389 98.0453 98.0453 98.6353 123.3079	655.505           92.95           65.551           94.48           94.62           93.07           93.2           95.05           93.2           95.05           93.2           95.05           93.52           93.15           94.42           65.597           66.407           95.12           96.2284           95.45           96.4478           96.4272           97.00*           97.0656           97.116
Dipoloceras cristatum Discorhabdus ignotus Eiffellithus turriseiffelii Ellipsagelosphaera ovata Eprolithus apertior Eprolithus floralis Euhopites lautus Euhopites loricatus Euhopites loricatus Euhystrichoceras nicaisei Euomphaloceras septemseriatum Favusella washitensis Forbesiceras beaumontianum Gartnerago nanum Gartnerago nanum Gartnerago nachum Gartnerago theia Gartnerago theia Gartnerago theia Gartnerago theia Gartnerago theia Gartnerago theia Gartnerago theia Hayesites albiensis Hedbergella libyca Helenea chiastia Helicolithus trabeculatus Hyphoplites coelonotus	-413.00 -236.00 -236.00 -236.00 -433.9713 -465.8373 -103.4988 108.6557 -139.916 -127.8239 -236.00 107.1837 -84.00 -139.916 -108.00 -127.82 -126.078 -126.078 -126.078 -126.078 -126.078 -236.00 -236.00 -236.00 -236.00 -236.00 -242.9187 -242.942	-436.8038 -406.00 -80.00 -80.00 -412.00 -436.8038 -436.8038 -132.84 108.6557 11.8706 -128.491 -86.00 -127.2379 -122.2930 -122.2930 -122.2930 -122.2930 -122.2930 -122.2930 -122.2930 -122.2930 -122.2930 -122.2930 -122.2930 -122.2930 -122.2930 -122.2930 -122.2930 -123.2970 -123.2970 -125.8070 -125.8070 -86.0000 -86.0000 -86.0000 -86.0000 -86.0000	105.5386 128.6386 101.856 121.959 122.8468 105.9188 106.9309 96.5874 93.88 114.1975 96.5524 99.2536 99.2536 96.5842 97.588 96.6353 96.6353 96.95* 96.92* 118.6477 103.6695 122.6533	104.1574 65.505 64.4399 88.1021 96.5423 85.5995 104.6453 105.0965 94.335 94.84 96.2621 94.23 64.743 *** 96.864 89.0722 96.864 89.0722 96.864 89.0722 96.864 89.0722 96.864 89.0722 96.864 89.0722 96.864 97.45 97.3296 92.7 65.505 106.93 97.4319	Rhagodiscus achlyostaurion           Rhagodiscus angustus           Rhagodiscus asper           Rhagodiscus asper           Rotalipora potzeni           Rotalipora brotzeni           Rotalipora brotzeni           Rotalipora deckei           Rotalipora gandolfi           Rotalipora gandolfi           Rotalipora genehornensis           Rotalipora greenhornensis           Rotalipora reicheli           Rotalipora reicheli           Rotalipora simplex           Scaphites simplex           Schlenbachia varians           Sciponoceras roto           Sharpeiceras schlueteri           Staurolithites glaber           Stoliczkaia africana           Stoliczkaia singar           Stoliczkaia singar	-236.00 -265.787 -268.787 -136.00 33.9508 23.6467 -139.016 -222.9565 -136.00 -100.0028 -59.5223 -1.00.01 -224.000 -224.000 -127.3889 -127.8239 -222.9565 -280.00 -222.9565 -280.00 -222.000 -222.000	-80,00 -80,00 -23,647 -119,00 101,6637 37,9989 -52,1622 88,7835 101,6637 99,8236 101,6637 32,1108 -80,00 -80,00 -42,2261 -103,4988 -112,000 -131,2738 -132,000 -280,00 -80,00	123.278 128.6386 123.278 100.5159 97.0842 96.17 97.588 98.9078 97.13 97.0842 97.384 97.0642 97.384 96.7056 124.612 134.0402 97.51* 97.0648 97.0648 97.0656 96.8389 96.9554 98.133 98.04* 98.6353 98.6353 98.6353 98.6353	655.505           92.95           65.551           94.48           93.07           93.2           95.05           93.15           93.07           93.15           93.07           93.15           94.42           65.597           66.407           ***           95.12           96.478           96.4778           97.00*           97.0056           97.116           83.3875
Dipoloceras cristatum Discorhabdus ignotus Eiffeilithus turriseiffelii Ellipsagelosphaera ovata Eprolithus apertior Eprolithus floralis Euhopites lautus Euhopites loricatus Euhystrichoceras nicaisei Euomphaloceras septemseriatum Favusella washitensis Forbesiceras beaumontianum Gartnerago nanum Gartnerago obliquum Gartnerago obliquum Gartnerago obliquum Gartnerago stenostauron Gartnerago stenostauron Gartnerago stenostauron Gartnerago theta Graysonites azregensis Graysonites cobbani Hamites virgulatus Hayesites albiensis Hedbergella libyca Helicolithus trabeculatus Hopites dentatus Hyphopites coelonotus	-413.00 -236.00 -236.00 -236.00 -433.9713 -465.8373 -103.4988 108.6557 -139.916 -127.8239 -236.00 107.1837 -64.00 -139.916 -108.00 -127.82 -126.0738 -191.1179 -232.00 -236.00 -224.00 -236.00 -224.00 -236.00 -224.01 -236.00 -224.01 -236.00 -224.01 -236.00 -224.01 -236.00 -224.01 -236.00 -224.01 -236.00 -224.01 -236.00 -224.01 -236.00 -224.01 -224.0	-436.8038 -406.00 -80.00 -40.00 -436.00 -436.038 -19.04 -436.837 11.8706 -12.8.9911 -96.00 128.691 -28.391	105.5386 128.6386 101.856 121.1235 122.8468 105.9188 106.9309 96.5874 98.286 99.286 99.286 99.286 99.286 96.5842 97.588 96.8353 96.582 96.582 96.582 96.582 96.72* 118.6477 100.6217 133.9695 122.8533 107.5967 97.4319 96.2621	104.1574 65.505 64.4399 88.1021 96.5423 85.5995 104.6453 105.8965 94.335 94.84 96.2621 94.23 64.743 *** 96.864 89.0722 96.94* 96.87* 97.3296 94.66 92.7 65.505 106.93 97.4319 96.08	Rhagodiscus achlyostaurion           Rhagodiscus angustus           Rhagodiscus asper           Rhagodiscus splendens           Rotalipora appenninica           Rotalipora brotzeni           Rotalipora deckei           Rotalipora gendolfi           Rotalipora greenhornensis           Rotalipora greenhornensis           Rotalipora montsalvensis           Rotalipora singlex           Schloenbachi avaians <t< td=""><td>-236.00 -265.787 -228.00 -265.787 -136.00 33.9508 23.6467 -139.916 -222.9565 -136.00 -136.00 -136.00 -234.00 -172.3889 -119.9188 -132.00 -76.0825 -224.00 -172.389 -232.00 -222.9565 -280.00 -280.00 -172.00</td><td>-80,00 -80,00 -80,00 23,647 -119,00 101,6637 37,9989 -52,1622 88,785 101,6637 99,8236 101,6637 32,1108 -80,00 -80,00 -42,2261 -112,000 -4131,2738 -1312,738 -132,000 -80,00 -80,00 -80,00</td><td>123.278 128.6386 123.278 100.5159 97.0842 96.077 97.588 98.0978 97.133 97.0842 97.384 96.706 124.612 134.0402 97.648 97.0656 96.6524 96.6339 96.6524 96.6353 98.04* 98.6353 98.6353 123.3079 123.3079</td><td>655.505           92.95           65.551           94.48           93.07           93.2           95.05           93.15           93.15           94.42           65.597           66.407           ***           95.12           96.2284           95.45           96.4778           96.4778           97.0656           97.116           83.3875           93.05</td></t<>	-236.00 -265.787 -228.00 -265.787 -136.00 33.9508 23.6467 -139.916 -222.9565 -136.00 -136.00 -136.00 -234.00 -172.3889 -119.9188 -132.00 -76.0825 -224.00 -172.389 -232.00 -222.9565 -280.00 -280.00 -172.00	-80,00 -80,00 -80,00 23,647 -119,00 101,6637 37,9989 -52,1622 88,785 101,6637 99,8236 101,6637 32,1108 -80,00 -80,00 -42,2261 -112,000 -4131,2738 -1312,738 -132,000 -80,00 -80,00 -80,00	123.278 128.6386 123.278 100.5159 97.0842 96.077 97.588 98.0978 97.133 97.0842 97.384 96.706 124.612 134.0402 97.648 97.0656 96.6524 96.6339 96.6524 96.6353 98.04* 98.6353 98.6353 123.3079 123.3079	655.505           92.95           65.551           94.48           93.07           93.2           95.05           93.15           93.15           94.42           65.597           66.407           ***           95.12           96.2284           95.45           96.4778           96.4778           97.0656           97.116           83.3875           93.05
Dipoloceras cristatum Discorhabdus ignotus Eiffellithus turriseiffelii Ellipsagelosphaera ovata Eprolithus apertior Eprolithus floralis Euhopites lautus Euhopites loricatus Euhopites loricatus Euhystrichoceras nicaisei Euomphaloceras septemseriatum Favusella washitensis Forbesiceras beaumontianum Gartnerago nanum Gartnerago nanum Gartnerago nachum Gartnerago theia Gartnerago theia Gartnerago theia Gartnerago theia Gartnerago theia Gartnerago theia Gartnerago theia Hayesites albiensis Hedbergella libyca Helenea chiastia Helicolithus trabeculatus Hyphoplites coelonotus	-413.00 -236.00 -236.00 -236.00 -433.9713 -465.8373 -103.4988 108.6557 -139.916 -127.8239 -236.00 107.1837 -84.00 -139.916 -108.00 -139.916 -108.00 -127.82 -24.00 -236.00	-436.8038 -406.00 -80.00 -112.00 -436.038 -436.038 -436.038 -19.04 -436.038 -19.04 -436.038 -19.04 -10.05 -10.05 -10.05 -128.301	105.5386 128.6386 101.856 121.959 122.4468 105.9188 106.9309 96.5874 93.88 114.1975 96.9524 98.296 99.296 96.5842 96.5842 97.588 96.8353 96.95* 96.92* 133.9695 122.8533 107.5987 97.4319 95.2621 97.51*	104.1574 65.505 64.4399 88.1021 96.5423 85.5995 104.6453 105.8965 94.34 96.2621 94.23 64.743 *** 96.864 89.0722 96.94* 96.87* 97.45* 97.3296 94.66 92.7 65.505 106.93 97.419 96.88 97.51*	Rhagodiscus achlyostaurion           Rhagodiscus angustus           Rhagodiscus asper           Rhagodiscus asper           Rotalipora potzeni           Rotalipora brotzeni           Rotalipora brotzeni           Rotalipora deckei           Rotalipora gandolfi           Rotalipora gandolfi           Rotalipora genehornensis           Rotalipora greenhornensis           Rotalipora reicheli           Rotalipora reicheli           Rotalipora simplex           Scaphites simplex           Schlenbachia varians           Sciponoceras roto           Sharpeiceras schlueteri           Staurolithites glaber           Stoliczkaia africana           Stoliczkaia singar           Stoliczkaia singar	-236.00 -265.787 -228.00 -265.787 -136.00 33.9508 23.6467 -136.00 -136.000 -100.0028 -59.5223 -1.0096 -234.00 -122.389 -119.9188 -132.00 -127.829 -224.00 -222.9565 -220.00 -220.00 -127.00 -230.00 -230.00 -367.6759	-80,00 -80,00 -23,647 -119,00 101,6637 37,9989 -52,1622 88,7835 101,6637 32,1108 -80,00 -80,00 -80,00 -42,2261 -103,4988 -131,2738 -132,000 -320,000 -80,00 -80,00 -80,00 -80,00 -80,00	123.278 128.6386 123.278 100.5159 97.0842 97.588 97.13 97.984 97.0842 97.384 96.706 124.612 134.0402 97.514 97.0648 97.0648 97.0656 96.9339 96.9524 99.6353 96.0353 96.0353 96.333 123.3079 129.3543 128.4545 110.9318	655.505           92.95           65.551           94.48           94.62           93.07           93.2           95.05           93.21           93.07           93.15           94.42           65.597           66.407           ***           95.12           96.2284           95.45           96.4772           97.00*           97.0656           97.116           83.3875           93.4606
Dipoloceras cristatum Discorhabdus ignotus Eiffellithus turriseiffelii Ellipsagelosphaera ovata Eprolithus apertior Eprolithus apertior Euhoplites lautus Euhoplites loricatus Euhystrichoceras nicaisei Euomphaloceras septemseriatum Favusella washitensis Forbesiceras beaumontianum Gartnerago nanum Gartnerago obliquum Gartnerago obliquum Gartnerago stenostauron Gartnerago stenostauron Gartnerago stenostauron Gartnerago stenostauron Gartnerago stenostauron Gartnerago stenostauron Hamites virgulatus Hayesites abliensis Hedbergella libyca Helenea chiastia Helicolithus trabeculatus Hyphoplites coelonotus Hyphoplites subfalcatus Hyphoplites subfalcatus	-413.00 -236.00 -236.00 -236.00 -433.9713 -465.8373 -103.4988 108.657 -139.916 -127.8239 -236.00 107.1837 -84.00 -139.916 -108.00 -127.82 -126.0738 -191.1179 -232.00 -236.00 -236.00 -224.00 -236.00	-436.8038 -406.00 -80.00 -112.00 -436.00 -436.8038 -19.04 -138.8038 -19.04 -128.8010 -128.8010 -128.8010 -127.2379 -122.200 -127.2379 -122.200 -127.2379 -122.200 -127.2379 -128.301 -128.301 -128.301 -128.301 -138.301 -1	105.5386 128.6386 101.856 121.959 121.1235 122.8468 105.9188 106.9309 96.5874 93.88 114.1975 96.9524 98.296 99.2536 96.524 97.588 96.52* 97.588 96.92* 118.6477 133.9695 122.6533 107.5987 97.4319 97.588	104.1574 65.505 64.4399 88.1021 96.5423 85.5995 104.6453 105.8965 94.335 94.84 96.2621 94.23 64.743 *** 96.864 89.0722 96.94* 96.87* 97.3296 94.66 92.7 65.505 106.93 97.4319 96.08	Rhagodiscus achlyostaurion           Rhagodiscus angustus           Rhagodiscus asper           Rhagodiscus asper           Rhagodiscus splendens           Rotalipora appenninica           Rotalipora brotzeni           Rotalipora brotzeni           Rotalipora deckei           Rotalipora deckei           Rotalipora gendoffi           Rotalipora gendoffi           Rotalipora gendoffi           Rotalipora greenhornensis           Rotalipora greenhornensis           Rotalipora greenhornensis           Rotalipora greenhornensis           Rotalipora greenhornensis           Rotalipora greenhornensis           Rotalipora sontsalvensis           Rotalipora sontsalvensis           Rotalipora sontsalvensis           Rotalipora sontsalvensis           Rotalipora sontsalvensis           Schloenbachia varians           Sciponoceras roto           Sharpeiceras schlueteri           Staurolithites glaber           Stoliczkaia africana           Stoliczkaia dispar           Stoverius achylosus           Tegumentum stradneri           Tetrapodorhabdus coptensis           Ticinella praeticinensis	-236.00 -265.787 -228.00 -265.787 -136.00 33.9508 23.6467 -139.916 -22.9655 -136.00 -240.00 -240.00 -240.00 -122.3955 -127.3839 -119.9188 -132.00 -76.0825 -222.9555 -228.000 -238.0000 -238.000 -238.000 -238.000 -238.000 -238.0000	-80,00 -80,00 -23,647 -119,00 -21,647 -119,00 -52,1622 88,785 -101,6637 -99,8236 -101,6637 -32,1108 -80,00 -80,00 -42,2261 -103,4988 -112,00 -42,2261 -103,4988 -112,00 -43,20 -131,2738 -132,00 -80,00 -80,00 -80,00 -80,00 -325,2222 -270,6389	123.278 128.6386 123.278 100.5159 97.0842 96.17 97.588 98.9078 97.588 97.0842 97.384 96.706 124.612 134.0402 97.514 97.0648 98.0337 98.0378	655.505           92.95           65.551           94.48           94.62           93.07           93.2           95.05           93.2           95.05           93.2           95.05           93.2           93.15           93.15           94.42           65.597           66.407           95.12           96.2284           95.45           96.4478           96.782           96.786           97.0656           97.116           97.116           93.8375           93.45           93.45
Dipoloceras cristatum Discorhabdus ignotus Eiffellifukus turriseiffelii Ellipsagelosphaera ovata Eprolithus apertior Eprolithus floralis Euhopites lautus Euhopites loricatus Euhopites loricatus Euhystrichoceras nicaisei Euomphaloceras septemseriatum Favusella washitensis Forbesiceras beaumontianum Gartnerago nanum Gartnerago obliquum Gartnerago obliquum Gartnerago obliquum Gartnerago senostauron Gartnerago stenostauron Gartnerago stenostauron Gartnerago stenostauron Gartnerago stenostauron Hamites virgulatus Hayesites abliensis Hedbergella libyca Helenea chiastia Helicolithus trabeculatus Hopites coelonotus Hyphopites falcatus	-413.00 -236.00 -236.00 -236.00 -433.9713 -465.8373 -103.4988 108.6557 -139.916 -127.8239 -236.00 107.1837 -84.00 -139.916 -108.00 -139.916 -108.00 -127.82 -24.00 -236.00	-436.8038 -406.00 -80.00 -112.00 -436.038 -436.038 -436.038 -19.04 -436.038 -19.04 -436.038 -19.04 -10.05 -10.05 -10.05 -128.301	105.5386 128.6386 101.856 121.959 122.4468 105.9188 106.9309 96.5874 93.88 114.1975 96.9524 98.296 99.296 96.5842 96.5842 97.588 96.8353 96.95* 96.92* 133.9695 122.8533 107.5987 97.4319 95.2621 97.51*	104.1574 65.505 64.4399 88.1021 96.5423 105.8965 94.5395 93.15 94.84 96.2621 94.23 64.743 *** 96.864 89.0722 96.94* 96.87* 97.45* 97.45* 97.45* 97.45* 97.45* 94.66 92.7 65.505 106.93 97.4319 96.08 97.51*	Rhagodiscus achlyostaurion           Rhagodiscus apper           Rhagodiscus apper           Rhagodiscus splendens           Rotalipora appenninica           Rotalipora brotzeni           Rotalipora brotzeni           Rotalipora brotzeni           Rotalipora decekei           Rotalipora decekei           Rotalipora decekei           Rotalipora gandolfi           Rotalipora gobotruncanoides           Rotalipora montsalvensis           Rotalipora reicheli           Rotelapillus laffittei           Scaphites simplex           Schloenbachia varians           Sciponoceras roto           Sharpeiceras laticlavicum           Staurolithites glaber           Stoliczkaia africana           Stoliczkaia dispar           Stoliczkaia dispar           Stoliczkaia dispar           Stoliczkaia fircana           Stoliczkaia dispar           Stoliczkaia dispar           Stoliczkaia fircana           Stoliczkaia fircana      <	-236.00 -265.787 -228.00 -265.787 -136.00 33.9508 23.6467 -136.00 -136.000 -100.0028 -59.5223 -1.0096 -234.00 -122.389 -119.9188 -132.00 -127.829 -224.00 -222.9565 -220.00 -220.00 -127.00 -230.00 -230.00 -367.6759	-80,00 -80,00 -23,647 -119,00 101,6637 37,9989 -52,1622 88,7835 101,6637 32,1108 -80,00 -80,00 -80,00 -42,2261 -103,4988 -131,2738 -132,000 -320,000 -80,00 -80,00 -80,00 -80,00 -80,00	123.278 128.6386 123.278 100.5159 97.0842 97.588 97.13 97.984 97.0842 97.384 96.706 124.612 134.0402 97.514 97.0648 97.0648 97.0656 96.9339 96.9524 99.6353 96.0353 96.0353 96.333 123.3079 129.3543 128.4545 110.9318	655.505           92.95           65.551           94.48           94.62           93.07           93.2           95.05           93.21           93.07           93.15           94.42           65.597           66.407           ***           95.12           96.2284           95.45           96.4772           97.00*           97.0656           97.116           83.3875           93.4606
Dipoloceras cristatum Discorhabdus ignotus Eiffellithus turriseiffelii Ellipsagelosphaera ovata Eprolithus apertior Eprolithus floralis Euhoplites lautus Euhoplites loricatus Euhystrichoceras nicaisei Euomphaloceras septemseriatum Farvusella washitensis Forbesiceras beaumontianum Gartnerago nanum Gartnerago obliquum Gartnerago obliquum Gartnerago stenostauron Gartnerago stenostauron Gartnerago stenostauron Gartnerago steta Graysonites azregensis Graysonites ablensis Hayeites albiensis Hedbergella libyca Helenea chiastia Helicolithus trabeculatus Hyphoplites coelonotus Hyphoplites subfalcatus Hyphoplites valbonnensis Hyphoplites valbonnensis	-413.00 -236.00 -236.00 -236.00 -433.9713 -465.8373 -103.4988 108.6557 -139.916 -127.8239 -236.00 107.1837 -84.00 -139.916 -108.00 -127.82 -126.0738 -191.1179 -232.00 -236.00 -224.00 -236.00 -242.942 -132.0523 -147.9187 -242.942 -132.0523 -149.0525 -180.00 -128.8911	-436.8038 -406.00 -80.00 -112.00 -436.8030 -436.8038 -436.8038 -19.04 108.6557 11.8706 -128.401 -28.401 -28.401 -28.401 -28.401 -212.2030 -122.2030 -122.2030 -122.2031 -45.8373 -6.000 -465.8373 -132.052 -132.052 -132.0537 -132.0537 -132.0537 -132.0537 -132.0537 -132.0537 -132.0537 -132.0537 -132.0537 -132.0537	105.5386 128.6386 101.856 121.1235 122.8468 105.9188 106.9309 96.5874 93.88 114.1975 96.9524 99.2536 96.9524 99.2536 96.9524 97.588 96.92* 97.71* 118.6477 100.6217 97.518 97.518 97.588 96.954	104.1574 65.505 64.4399 88.1021 96.5423 105.8965 94.5395 94.5395 94.5395 94.54 94.23 64.743 *** 96.2621 94.23 64.743 *** 96.864 89.0722 96.94* 97.45* 97.45* 97.45* 97.4319 96.08 97.51* 97.51*	Rhagodiscus achlyostaurion           Rhagodiscus angustus           Rhagodiscus asper           Rhagodiscus asper           Rotalipora appenninica           Rotalipora brotzeni           Rotalipora deckei           Rotalipora gandolfi           Rotalipora gandolfi           Rotalipora genhornesis           Rotalipora genhornensis           Rotalipora greenhornensis           Rotalipora rontsalvensis           Rotalipora rontsalvensis           Rotalipora singlex           Scaphites simplex           Sciponoceras laticlavicum           Sharpeiceras laticlavicum           Sharpeiceras laticlavicum           Stoliczkaia afrizena           Stoliczkaia daispar	-236.00 -265.787 -265.787 -136.00 23.6467 -139.916 -222.9565 -136.00 -224.900 -236.00 -240.00 -240.00 -172.389 -132.00 -76.0825 -127.8239 -232.00 -222.9565 -127.8239 -232.00 -228.000 -228.000 -228.000 -280.	-80,00 -80,00 -23,647 -119,00 101,6537 37,9989 -52,1622 88,7835 101,6637 32,1108 -80,00 -80,00 -80,00 -42,2261 -103,4988 -112,00 -131,2738 -132,000 -80,000 -80,0	123.278 128.6386 123.278 100.5159 97.0842 96.17 95.3597 97.588 99.0978 97.13 97.0842 97.0842 97.0842 97.0842 97.0848 97.0646 97.0656 96.8389 99.0554 97.0656 96.8389 99.0554 98.04 <sup>35</sup> 98.04 <sup>35</sup> 98.04 <sup>35</sup> 98.04 <sup>35</sup> 123.3079 129.3543 128.455 110.9318 111.6144 103.1399	655.505           92.95           65.551           94.48           94.62           93.07           93.2           95.05           93.2           95.05           93.2           93.07           93.52           93.15           94.42           65.597           66.407           95.12           96.2284           95.45           96.4478           96.745           97.00*           97.005           97.116           83.3875           93.05           93.05           93.05           93.06           97.466           97.3667           97.82
Dipoloceras cristatum Discorhabdus ignotus Eiffellihus turriseiffelii Ellipsagelosphaera ovata Eprolithus apertior Eprolithus floralis Euhopites lautus Euhopites loricatus Euhopites loricatus Euhystrichoceras nicaisei Euomphaloceras septemseriatum Favusella washitensis Forbesiceras beaumontianum Gartnerago nanum Gartnerago nanum Gartnerago nanum Gartnerago nanum Gartnerago nanum Gartnerago theta Graysonites azregensis Graysonites azregensis Graysonites ablensis Hedbergella libyca Helenea chiastia Helicolithus trabeculatus Helicolithus trabeculatus Hyphopites coelonotus Hyphopites falcatus Hyphopites valbonnensis Hyphopites garvesianus	-413.00 -236.00 -236.00 -236.00 -433.9713 -465.8373 -103.4988 108.6557 -139.916 -127.8239 -236.00 107.1837 -84.00 -139.916 -108.00 -127.82 -126.0738 -191.1179 -232.00 -236.0	-436.8038 -406.00 -80.00 -80.00 -412.00 -436.8030 -436.8038 -139.44 108.6557 11.8706 -128.461 -29.461 -29.461	105.5386 128.6386 121.959 121.1235 122.8468 105.9188 106.9309 96.5874 96.5874 96.5824 97.588 96.5842 97.588 96.68353 96.5842 97.71* 118.6477 100.6217 133.9695 122.6533 107.5897 97.4319 96.2621 97.51* 97.588	104.1574 65.505 64.4399 88.1021 96.5423 85.5995 104.6453 105.0965 94.335 94.84 94.23 64.743 *** 96.864 89.0722 96.94* 96.864 89.0722 96.94* 97.3296 92.7 65.505 106.93 97.4319 96.08 97.51* 97.5888 94.84 96.3536	Rhagodiscus achlyostaurion           Rhagodiscus angustus           Rhagodiscus asper           Rhagodiscus asper           Rotalipora protzeni           Rotalipora brotzeni           Rotalipora deckei           Rotalipora gandolfi           Rotalipora gandolfi           Rotalipora geneninica           Rotalipora greenhornensis           Rotalipora reicheli           Rotalipora reicheli           Rotalipora reicheli           Rotalipora reicheli           Rotalipora reicheli           Sciponoceras roto           Sharpeiceras schlueteri           Staurolithites glaber           Stoliczkaia africana           Stoliczkaia faricana           Stoliczkaia dispar           Stoliczkaia dispar           Stoliczkaia africana           Stoliczkaia dispar           Stoliczkaia dispar           Stoliczkaia dispar           Stoliczkaia dispar	-236.00 -265.787 -268.087 -268.087 -336.00 -33.9508 23.6467 -139.016 -222.9565 -340.00 -224.000 -224.000 -224.000 -224.000 -224.000 -127.0309 -222.9565 -280.00 -222.9565 -280.00 -220.00 -220.00 -220.00 -367.6759 -393.1481 -395.2222	-80,00 -80,00 -23,647 -119,00 101,6637 37,9989 -52,622 88,7835 101,6637 32,108 -80,00 -80,00 -42,2261 -13,4988 -112,00 -42,2261 -133,4988 -112,00 -42,2261 -133,4988 -112,00 -80,00 -280,00 -80,00 -325,222 -270,6389 -323,00 -232,00 -323,00 -325,222	123.278 128.6386 123.278 100.5159 97.0842 96.17 97.588 98.9078 97.13 97.0842 97.384 97.0642 97.384 96.0561 96.6389 96.6353 98.04* 98.635 98.635 98.635 123.3079 123.3379 123.3454 110.613 111.614	65.505           92.95           65.551           94.48           93.07           93.2           95.05           93.15           93.07           93.15           93.07           93.15           94.42           65.597           66.407           ***           95.12           96.478           96.478           96.8772           97.00*           97.116           83.3875           93.05           97.4606           97.3667           97.3667           97.4606           97.3667           97.4606           97.3667           97.3667           97.3667           97.3667
Dipoloceras cristatum Discorhabdus ignotus Eiffeilithus turriseiffelii Ellipsagelosphaera ovata Eprolithus apertior Eprolithus apertior Euhopites lautus Euhopites loricatus Euhopites loricatus Euhystrichoceras nicaisei Euomphaloceras septemseriatum Favusella washitensis Forbesiceras beaumontianum Gartnerago nanum Gartnerago nanum Gartnerago paeobliquum Gartnerago paeobliquum Gartnerago stenostauron Gartnerago stenostauron Gartnerago stenostauron Gartnerago stenostauron Gartnerago stenostauron Hamites virgulatus Hayesites albiensis Helbergella libyca Helenea chiastia Helicolithus trabeculatus Hopites coelonotus Hyphopites coelonotus Hyphopites subfalcatus Hyphopites subfalcatus Hyphopites subfalcatus Hyphopites subfalcatus Hyphopites subfalcatus Hyphopites subfalcatus Hyphopites subfalcatus Hyphopites subfalcatus Hyphopites subfalcatus Hyphopites subfalcatus	-413.00 -236.00 -236.00 -236.00 -433.9713 -465.8373 -103.4988 108.6557 -139.916 -127.8239 -236.00 107.1837 -64.00 -139.916 -108.00 -127.82 -126.0738 -191.1179 -232.00 -236.00 -224.00 -236.00 -236.00 -236.00 -236.00 -24.917 -24.918	-436.8038 -406.00 -80.00 -412.00 -436.038 -436.038 -19.04 -19.04 -19.04 -10.455 -11.8708 -128.9911 -96.06 -127.299 -128.991 -127.299 -127.299 -127.299 -127.299 -127.299 -127.291 -127.291 -127.291 -137.025 -155.001 -132.0528 -19.025 -155.001 -132.0528 -19.025 -155.001 -132.0528 -19.025 -155.001 -132.0528 -19.025 -155.001 -132.0528 -19.025 -155.001 -132.0528 -155.001 -132.0528 -155.001 -132.0528 -155.001 -132.0528 -155.001 -132.0528 -155.001 -132.0528 -155.001 -132.0528 -155.001 -132.0528 -155.001 -132.0528 -155.001 -132.0528 -155.001 -132.0528 -155.001 -132.0528 -155.001 -132.0528 -155.001 -132.0528 -155.001 -132.0528 -132.001 -132.0528 -132.001 -132.0528 -132.001 -132.0	105.5386 128.6386 101.856 121.1235 122.8468 105.9188 106.9309 96.5874 98.286 114.1975 96.9524 98.296 99.2586 99.2586 96.5842 96.5842 96.5842 96.5842 107.5867 122.8533 107.5867 97.4319 96.2621 97.51* 96.5868 96.9554 104.226	104.1574 65.505 64.4399 88.1021 96.5423 85.5995 104.6453 105.8965 94.335 94.23 64.743 96.2621 94.23 64.743 *** 96.864 89.0722 96.94* 97.6587 97.3296 94.66 92.7 65.505 106.93 97.4319 96.08 97.4319 96.08 97.51* 96.336 94.84 96.3536 101.71	Rhagodiscus achlyostaurion           Rhagodiscus angustus           Rhagodiscus asper           Rhagodiscus splendens           Rotalipora appenninica           Rotalipora brotzeni           Rotalipora brotzeni           Rotalipora brotzeni           Rotalipora brotzeni           Rotalipora deckei           Rotalipora deckei           Rotalipora gendolfi           Rotalipora godobtruncanoides           Rotalipora greenhornensis           Rotalipora greenhornensis           Rotalipora montsalvensis           Rotalipora singlex           Schloenbachia varians           Sciponceras iscilcavicum           Sharpeiceras schlueteri           Stoliczkaia dispar           Stoliczkaia dispar           Stoverius achlyosus	-236.00 -265.787 -228.00 -265.787 -136.00 33.9508 23.6467 -136.00 -136.00 -136.00 -136.00 -230.00 -234.00 -172.3889 -119.9188 -132.00 -76.0825 -224.00 -172.389 -232.00 -222.9565 -280.00 -222.9565 -280.00 -230.00 -230.00 -367.6759 -393.1481 -367.6759 -393.1481	-80,00 -80,00 -23,647 -119,00 101,6637 37,9989 -52,1622 88,785 101,6637 32,1108 -101,6637 32,1108 -80,00 -80,00 -42,226 -38,00 -42,226 -38,00 -42,226 -38,00 -42,226 -38,00 -42,226 -38,00 -42,226 -38,00 -42,226 -38,00 -42,226 -38,00 -42,226 -38,00 -42,226 -38,00 -42,226 -38,00 -42,226 -38,00 -38,00 -38,00 -38,00 -38,00 -38,00 -38,00 -38,00 -38,00 -325,222 -27,0389 -232,00 -325,222 -27,232,00 -27,232,0	123.278 128.6386 123.278 100.5159 97.0842 96.077 97.588 98.0978 97.133 97.0842 97.0842 97.0842 97.0848 97.0656 97.0656 97.0656 96.6524 97.0656 96.6524 96.6333 98.04* 96.6353 98.038 123.3079 129.5543 129.5543 129.5435 110.9318 111.614 103.1399 123.9877	655.505           92.95           65.551           94.48           93.07           93.2           95.05           93.15           93.15           93.15           93.15           94.42           65.597           66.407           ***           95.12           96.2284           95.45           96.4778           96.4770           97.0656           97.116           83.3575           93.05           97.4606           97.3667           97.82           96.83779           83.5584
Dipoloceras cristatum Discorhabdus ignotus Eiffellithus turriseiffelii Ellipsagelosphaera ovata Eprolithus apertior Eprolithus apertior Euhopites lautus Euhopites loricatus Euhopites loricatus Euhystrichoceras nicaisei Euomphaloceras septemseriatum Favusella washitensis Forbesiceras beaumontianum Gartnerago nanum Gartnerago nanum Gartnerago obliquum Gartnerago obliquum Gartnerago stenostauron Gartnerago stenostauron Gartnerago stenostauron Gartnerago stenostauron Gartnerago stenostauron Hamites virgulatus Hayesites abliensis Helenea chiastia Helicolithus trabeculatus Helenea chiastia Helicolithus trabeculatus Hyphopites coelonotus Hyphopites falcatus Hyphopites subfalcatus Hyphopites qavesianus Hyphoturrilites gravesianus Hyphoturites celegantulus	-413.00 -236.00 -236.00 -236.00 -236.00 -433.9713 -465.8373 -103.4988 108.6557 -139.916 -127.8239 -236.00 107.1837 -84.00 -139.916 -108.00 -127.82 126.0738 -191.1179 -232.00 -236.00	-436.8038 -406.00 -80.00 -81.00 -436.8038 -436	105.5386 128.6386 101.856 121.959 122.4468 105.9188 106.9309 96.5874 93.88 114.1975 96.9524 98.296 96.5842 96.5842 96.5842 96.5842 97.588 96.6353 107.5987 122.8533 107.5987 122.8533 107.5987 97.4319 96.4221 97.5888 96.8844 96.8521 104.225 96.8533 104.225 96.8533 104.225 96.8544 96.8545 104.225 96.8544 96.8545 104.225 98.31*	104.1574 65.505 64.4399 88.1021 96.5423 85.5995 104.6453 105.8965 94.395 93.15 94.44 96.2621 94.23 64.743 *** 96.864 89.0722 96.94* 97.686 97.45* 97.45* 97.45* 97.45* 97.45* 97.45* 97.45* 97.588 94.84 96.83 94.84 96.336 101.71 98.29*	Rhagodiscus achlyostaurion           Rhagodiscus angustus           Rhagodiscus asper           Rhagodiscus splendens           Rotalipora appenninica           Rotalipora brotzeni           Rotalipora brotzeni           Rotalipora brotzeni           Rotalipora deckei           Rotalipora evoluta           Rotalipora gendolfi           Rotalipora gendolfi           Rotalipora gendolfi           Rotalipora greenhornensis           Schlopstaius greenulatus           Rotalipora greenulatus           Schloenbachi varians           Schloenbachi varians           Schloenbachi as africana	-236.00 -265.787 -228.00 -265.787 -136.00 33.9508 23.6467 -136.00 -136.000 -136.000 -100.028 -59.5223 -1.0096 -224.005 -224.005 -224.005 -224.005 -224.005 -222.9565 -230.00 -222.9565 -230.00 -230.00 -367.6759 -393.1481 -367.6759 -393.1481 -367.6759 -393.1481 -367.6759 -393.1481 -367.6759 -320.00	-80,00 -80,00 -23,647 -119,00 101,6637 37,9989 -52,1622 88,7835 101,6637 32,108 -80,00 -80,00 -80,00 -103,00 -112,00 -131,2738 -132,00 -80,00 -80,00 -80,00 -80,00 -80,00 -325,2222 -270,6389 -232,00 -140,00 -132,00	123.278 128.6386 123.278 100.5159 97.0842 96.077 97.588 97.0842 97.384 97.0842 97.384 96.0706 124.612 134.0402 97.51* 97.0648 97.0656 96.9524 96.0353 98.035 98.035 98.035 123.3079 128.4545 110.9318 111.614 103.1399 101.8279 98.0074	655.505           92.95           65.551           94.48           93.07           93.2           95.05           93.15           93.15           94.42           65.597           66.407           ***           95.12           96.2284           95.45           96.4772           97.0656           97.116           83.3875           93.05           97.4606           97.3667           97.82           96.83584           65.505
Dipoloceras cristatum Discorhabdus ignotus Eiffellifus turriseiffelii Ellipsagelosphaera ovata Eprolithus apertior Eprolithus apertior Euhopites lautus Euhopites loricatus Euhopites loricatus Euhystrichoceras nicaisei Euomphaloceras septemseriatum Favusella washitensis Forbesiceras beaumontianum Gartnerago nanum Gartnerago obliquum Gartnerago paeobliquum Gartnerago stenostauron Gartnerago stenostauron Gartnerago stenostauron Gartnerago theta Graysonites azregensis Graysonites azregensis Hamites virgulatus Hayesites abliensis Hedbergella libyca Helenea chiastia Helicolithus trabeculatus Hyphoplites falcatus Hyphoplites subfalcatus Hyphoplites subfalcatus Hyphoplites subfalcatus Hyphoplites valbonnensis Hyphoplites valbonnensis Hyphoplites elegantulus Inoceramus anglicus	-413.00 -236.00 -236.00 -236.00 -433.9713 -465.8373 -103.4988 108.6557 -139.916 -127.8239 -236.00 107.1837 -84.00 -139.916 -108.00 -139.916 -108.00 -236.00 -236.00 -236.00 -236.00 -234.00 -236.00 -24.942 -130.0253	-436.8038 -406.00 -80.00 -81.00 -436.8038 -436.8038 -19.04 -19.04 -13.8057 11.8706 -128.8010 -128.8010 -128.8010 -128.8010 -128.301 -128.301 -128.301 -128.301 -128.301 -128.301 -128.301 -139.0	105.5386 128.6386 101.856 121.959 121.1235 122.4468 105.9188 106.9309 96.5874 93.88 114.1975 96.9524 98.296 99.2536 96.524 97.588 96.52* 97.588 96.92* 100.6217 133.9695 122.6533 107.5967 97.4319 96.2621 97.588 96.9644 96.9524 104.2526 96.31* 104.2526 96.32* 96.32* 96.32* 96.32* 96.32* 96.32* 96.32* 97.588 96.32* 96.32* 96.32* 96.32* 96.32* 97.588 96.32* 97.588 96.32* 96.32* 96.32* 96.32* 97.588 96.32* 97.588 96.32* 97.588 96.32* 97.588 96.32* 96.32* 97.588 96.32* 97.588 96.32* 97.588 96.32* 97.588 96.32* 97.588 96.32* 97.588 96.32* 97.588 96.32* 97.588 96.32* 97.588 96.32* 97.588 96.32* 97.588 96.32* 97.588 96.32* 97.588 96.32* 97.588 96.32* 97.5888 97.5888 97.5	104.1574 65.505 64.4399 88.1021 96.5423 105.8965 94.5395 93.15 94.84 96.2621 94.23 64.743 *** 96.864 89.0722 96.94* 96.87* 97.45* 97.45* 97.45* 97.45* 97.45* 97.65 106.93 97.4319 96.88 97.51* 97.5888 94.84 96.8536 101.71 98.29* 96.7098	Rhagodiscus achlyostaurion           Rhagodiscus angustus           Rhagodiscus asper           Rhagodiscus splendens           Rotalipora appenninica           Rotalipora brotzeni           Rotalipora brotzeni           Rotalipora decekei           Rotalipora decekei           Rotalipora decekei           Rotalipora geonturacancides           Rotalipora greenhormensis           Scholenbachia varians           Scholenbachia varians           Scholenbachia varians           Scholenbachia varians           Scholenbachia varians           Scholenbachia varians           Stoliczkaia africana           Stoliczkaia clavigera           Stoliczkaia dispar           Stove	-236.00 -265.787 -228.00 -265.787 -136.00 33.9508 23.6467 -136.00 -136.00 -22.05 -136.00 -22.00 -224.00 -122.389 -119.9188 -123.389 -119.9188 -123.389 -123.00 -224.00 -224.00 -222.955 -280.00 -222.955 -280.00 -222.955 -280.00 -220.00 -230.00 -367.6759 -325.222 -325.222 -325.222 -325.222 -325.222 -325.222	-80,00 -80,00 -23,647 -119,00 101,6537 37,9989 -52,1622 88,7835 101,6637 32,1108 -99,8236 101,6637 32,1108 -80,00 -80,00 -80,00 -32,00 -112,00 -80,00 -80,00 -325,2222 -270,6389 -232,00 -140,00 -30,0	123.278 128.6386 123.278 100.5159 97.0842 96.17 97.588 98.9078 97.384 97.0842 97.384 96.706 124.612 134.0402 97.51* 97.0648 98.0339 98.0353 98.0353 98.0353 98.0353 98.0353 98.0353 98.0353 98.0353 98.0353 98.0353 98.0353 98.0353 123.3079 123.8457 123.9877 124.9455 123.9877 124.9455 125.9877 125.9877 125.9877 125.9877 125.9877 125.9877 125.9877 125.9877 125.9877 125.9877 125.9877 125.9877 125.9877 125.9877 125.9877 125.9877 125.9877 125.9877 125.98777 125.98777 125.98777 125.98777 125.977777 125.97777777 125.9777777777777777777777777777777777777	655.505           92.95           65.551           94.48           94.62           93.07           93.2           95.05           93.2           93.07           93.2           93.07           93.15           93.15           94.42           65.597           66.407           95.12           96.2284           95.45           96.4278           96.6272           97.0656           97.116           97.3657           93.353           97.4606           97.3667           97.82           96.8779           93.3584           65.505           69.1743
Dipoloceras cristatum Discorhabdus ignotus Eiffellithus turriseiffelii Ellipsagelosphaera ovata Eprolithus floralis Euhoplites lautus Euhoplites loricatus Euhoplites loricatus Euhystrichoceras nicaisei Euomphaloceras septemseriatum Favusella washitensis Forbesiceras beaumontianum Gartnerago nanum Gartnerago obliquum Gartnerago obliquum Gartnerago obliquum Gartnerago stenostauron Gartnerago stenostauron Gartnerago stenostauron Gartnerago stenostauron Gartnerago stenostauron Hamtes virgulatus Hayesites abliensis Hedbergella libyca Helenee chiastia Helicolithus trabeculatus Hyphoplites coelonotus Hyphoplites subfalcatus Hyphoplites subfalcatus Hyphoplites subfalcatus Hyphoplites subfalcatus Hyphoplites subfalcatus Hyphoplites coelonotus Hyphoplites subfalcatus Hyphoplites subfalcatus Hyphoplites subfalcatus Hyphoplites corbignyi Idohamites elegantulus Inoceramus anglicus	-413.00 -236.00 -236.00 -236.00 -433.9713 -465.8373 103.4988 108.6557 -139.916 -127.8239 -236.00 107.1837 -84.00 -139.916 -108.00 -127.82 -126.0738 -191.1179 -232.00 -236.00 -224.00 -236.00 -224.01 -236.00 -242.942 107.137 -242.942 -130.523 -179.025 -180.00 -128.8911 -127.8239 -33.00 -248.88 -130.00 -248.88 -130.00 -248.88 -130.00 -248.88 -130.00 -248.88 -130.00 -248.88 -130.00 -248.88 -130.00 -248.88 -130.00 -248.88 -130.00 -245.00 -245.00 -248.88 -130.00 -245.00 -245.00 -248.88 -130.00 -248.88 -130.00 -248.88 -130.00 -248.88 -130.00 -248.88 -130.00 -248.88 -130.00 -248.88 -130.00 -248.88 -130.00 -248.88 -130.00 -248.88 -130.00 -248.88 -130.00 -248.88 -130.00 -248.88 -130.00 -248.88	-436.8038 -406.00 -80.00 -36.00 -436.803 -436.803 -436.803 -19.04 108.6557 11.8706 -128.401 -28.601 -128.401 -128.401 -128.401 -127.2370 -122.2903 -122.2903 -122.2903 -122.905 -122.2905 -122.905 -122.905 -122.905 -122.905 -123.005 -123.005 -123.005 -125.0037 -135.0037 -135.0037 -135.0037 -135.0037 -135.0037 -135.0037	105.5386 128.6386 101.856 121.959 121.1235 122.8468 105.9188 106.9309 96.5874 93.88 114.1975 96.9524 98.296 99.2536 96.9524 99.2536 96.9524 99.2536 96.957 96.927 118.6477 100.6217 133.9695 122.8533 107.5987 97.4319 96.2521 97.5888 96.9524 104.226 98.31* 104.1574 104.1574 104.1574	104.1574 65.505 64.4399 88.1021 96.5423 105.8965 94.5395 94.84 94.23 64.743 *** 96.6221 94.23 64.743 *** 96.864 92.7 96.87* 97.45* 97.45* 106.93 97.4319 96.08 97.4319 96.08 97.588 97.588 94.84 95.555 106.93 97.4319 96.08 97.588 97.588 94.84 96.3536 101.71 98.29* 96.798 101.71	Rhagodiscus achlyostaurion           Rhagodiscus angustus           Rhagodiscus asper           Rhagodiscus asper           Rotalipora appenninica           Rotalipora brotzeni           Rotalipora deckei           Rotalipora gandoffi           Rotalipora gandoffi           Rotalipora genhomica           Rotalipora gandoffi           Rotalipora genhomensis           Rotalipora genhomensis           Rotalipora genhomensis           Rotalipora genhomensis           Rotalipora romtsalvensis           Rotalipora romtsalvensis           Rotalipora romotsalvensis           Rotalipora romotsalvensis           Rotalipora as previdentis           Rotalipora soto           Rotalipora romotsalvensis           Rotalipora romotsalvensis           Rotalipora soto           Sharpeiceras laticlavicum           Sharpeiceras laticlavicum           Sharpeiceras laticlavicum           Stauroithites glaber           Stoliczkaia africana           Stoliczkaia dispar           Stoverius achylosus           Tegumentum stradneri           Tetrapodorhabdus coptensis           Ticinella praeticinensis           Ticinella primula	-236.00 -265.787 -265.787 -136.00 23.6467 -139.916 -22.965 -136.00 -22.00 -100.0028 -39.5223 -1.0096 -236.00 -224.00 -172.389 -119.9188 -132.00 -172.389 -222.965 -228.000 -228.000 -228.000 -228.000 -228.000 -367.6759 -393.1481 -367.6759 -393.1481 -367.6759 -325.2222 -230.00 -220.000 -220.000	-80,00 -80,00 -23,647 -119,00 -119,00 -52,1622 88,7835 101,6637 99,6236 101,6637 32,1108 -80,00 -80,00 -80,00 -42,2261 -103,4988 -112,00 -42,2261 -103,4988 -112,00 -80,00 -80,00 -80,00 -80,00 -80,00 -80,00 -80,00 -80,00 -80,00 -80,00 -325,2222 -270,6389 -232,00 -3132,00 -3	123.278 128.6386 123.278 100.5159 97.0842 96.17 95.3597 97.588 96.9078 97.134 97.0842 97.0842 97.084 97.084 97.084 97.064 97.064 97.064 97.0656 96.8389 98.043 98.043 98.043 98.043 123.3079 129.353 128.4545 110.9318 111.614 103.1399 101.8279 129.8077 98.0074 110.9137 98.0074 110.9137 98.0074 110.9137 98.0074 110.9137 98.0074 110.9137 98.0074 110.9137 98.0074 110.9137 98.0074 110.9137 98.0074 110.9137 98.0074 110.9137 98.0074 110.9137 98.0074 110.9137 98.0074 110.9137 98.0074 110.9137 98.0074 110.9137 98.0074 110.9137 98.0074 110.9137 98.0074 110.9137 123.977 98.0074 110.9137 123.977 98.0074 110.9137 123.977 123.977 123.977 123.977 123.977 123.977 123.977 123.977 123.98777 123.9877 123.9877 123.98777 12	655.505           92.95           65.551           94.48           93.07           93.2           95.05           93.7           93.52           93.15           94.42           65.597           93.15           94.42           65.597           66.407           95.12           96.2284           95.45           96.4478           96.745           97.00*           97.005           97.116           97.315           93.83875           93.05           97.166           97.365           97.365           97.365           97.365           97.365           97.365           97.82           96.8779           83.5584           65.555           69.1743           93.98
Dipoloceras cristatum Discorhabdus ignotus Eiffellihus turriseiffelii Ellipsagelosphaera ovata Eprolithus apertior Eprolithus floralis Euhopites lautus Euhopites loricatus Euhopites loricatus Euhopites loricatus Euhystrichoceras nicaisei Euomphaloceras septemseriatum Favusella washitensis Forbesiceras beaumontianum Gartnerago nanum Gartnerago nanum Gartnerago nanum Gartnerago nanum Gartnerago praeobliquum Gartnerago theta Graysonites azregensis Graysonites azregensis Graysonites azregensis Hedbergella libyca Hayeites albiensis Helenea chiastia Helicolithus trabeculatus Helicolithus trabeculatus Hyphopites coelonotus Hyphopites subfalcatus Hyphopites valbonnensis Hyphopites valbonnensis Hyphopites qarvesianus Hyphopites garvesianus Hyphopites garvesianus Hyphopites coelonotus Hyphopites schneegansi Hyphopites coelonotus Hyphopites subfalcatus Hyphopites subfalcatus Hyphopites subfalcatus Hyphopites subfalcatus Hyphopites schneegansi Hyptorrriites gravesianus Hypotarriites gravesianus Inoceramus anglicus Inoceramus concentricus	-413.00 -236.00 -236.00 -236.00 -336.00 -343.9713 -465.8373 -103.4988 108.6557 -139.916 -127.8239 -236.00 107.1837 -84.00 -139.916 -108.00 -127.823 -139.916 -108.00 -236.00 -	-436.8038 -406.00 -80.00 -80.00 -412.00 -436.8038 -436.8038 -139.44 108.6557 11.8706 -128.461 -29.461 -29.461	105.5386 128.6386 121.859 121.1235 122.8468 105.9188 106.9309 96.5874 93.88 114.1975 96.9524 98.296 99.256 99.2582 96.5822 97.588 96.6353 96.92* 113.6477 100.6217 113.6477 100.6217 122.8533 107.5897 97.4319 96.2621 97.51* 97.5188 96.9524 107.587 97.5888 96.9524 107.517 97.5188 96.9524 107.517 97.5188 96.9524 107.517 97.5188 96.9524 104.256 96.9524 104.1574	104.1574 65.505 64.4399 88.1021 96.5423 85.5995 104.6453 105.8965 94.335 94.84 94.23 64.743 *** 96.864 89.0722 96.94* 96.864 89.0722 96.94* 97.3296 97.3296 92.7 65.505 106.93 97.4319 96.08 97.51* 106.93 97.51* 96.75888 94.84 96.3536 101.71 98.29* 96.7988	Rhagodiscus achlyostaurion           Rhagodiscus angustus           Rhagodiscus asper           Rhagodiscus appenninica           Rotalipora brotzeni           Rotalipora brotzeni           Rotalipora deckei           Rotalipora gandolfi           Rotalipora gandolfi           Rotalipora geneninica           Rotalipora greenhornensis           Rotalipora reicheli           Rotalipora reicheli           Rotalipora reicheli           Rotalipora reicheli           Rotalipora reicheli           Rotalipora reicheli           Rotalipora solutes           Rotalipora reicheli           Sciponoceras roto           Sharpeiceras schlueteri           Staurolithites glaber           Stoliczkaia africana           Stoliczkaia dispar           Stoliczkaia dispar           Stoliczkaia adispar           Stoliczkaia abiparenis           Ticinella primula           Ticinella primula <td>-236.00 -265.787 -228.00 -265.787 -136.00 33.9508 23.6467 -139.01 -222.955 -136.00 -236.00 -224.00 -224.00 -224.00 -224.00 -224.00 -224.00 -127.039 -224.00 -224.00 -172.03 -229.955 -280.00 -280.00 -280.00 -367.6759 -393.148 -395.148 -393</td> <td>-80,00 -80,00 -23,647 -119,00 101,6637 37,9989 -52,622 88,7835 101,6637 32,1108 -80,00 -80,00 -42,2261 -38,00 -42,2261 -13,4988 -112,00 -43,238 -132,788 -132,788 -132,788 -132,788 -132,788 -132,788 -132,788 -132,788 -132,788 -232,00 -232,</td> <td>123.278 128.6386 123.278 100.5159 97.0842 96.17 97.588 98.9078 97.13 97.0842 97.384 97.0642 97.384 124.612 134.0402 97.51* 97.0648 97.0648 97.0648 97.0648 97.0656 96.6359 96.6353 98.645 98.6353 123.3079 123.3079 123.9877 98.044 111.614 113.1349 101.8279 123.9877 98.045 110.9137 110.9137 110.9157 110.9157 110.9157 110.9157 110.9157 110.9157 110.9157 10</td> <td>65.505           92.95           65.551           94.48           93.07           93.2           95.05           93.15           93.07           93.15           93.07           93.15           94.42           65.597           66.407           ***           95.12           96.478           96.477           97.0656           97.116           97.0656           97.116           93.3875           93.05           97.4606           97.3667           97.3667           97.4606           97.3667           97.3667           97.3667           97.3667           97.3667           97.3667           97.3667           97.383,584           65.505           69.1743           93.98           94.14</td>	-236.00 -265.787 -228.00 -265.787 -136.00 33.9508 23.6467 -139.01 -222.955 -136.00 -236.00 -224.00 -224.00 -224.00 -224.00 -224.00 -224.00 -127.039 -224.00 -224.00 -172.03 -229.955 -280.00 -280.00 -280.00 -367.6759 -393.148 -395.148 -393	-80,00 -80,00 -23,647 -119,00 101,6637 37,9989 -52,622 88,7835 101,6637 32,1108 -80,00 -80,00 -42,2261 -38,00 -42,2261 -13,4988 -112,00 -43,238 -132,788 -132,788 -132,788 -132,788 -132,788 -132,788 -132,788 -132,788 -132,788 -232,00 -232,	123.278 128.6386 123.278 100.5159 97.0842 96.17 97.588 98.9078 97.13 97.0842 97.384 97.0642 97.384 124.612 134.0402 97.51* 97.0648 97.0648 97.0648 97.0648 97.0656 96.6359 96.6353 98.645 98.6353 123.3079 123.3079 123.9877 98.044 111.614 113.1349 101.8279 123.9877 98.045 110.9137 110.9137 110.9157 110.9157 110.9157 110.9157 110.9157 110.9157 110.9157 10	65.505           92.95           65.551           94.48           93.07           93.2           95.05           93.15           93.07           93.15           93.07           93.15           94.42           65.597           66.407           ***           95.12           96.478           96.477           97.0656           97.116           97.0656           97.116           93.3875           93.05           97.4606           97.3667           97.3667           97.4606           97.3667           97.3667           97.3667           97.3667           97.3667           97.3667           97.3667           97.383,584           65.505           69.1743           93.98           94.14

**Table 2:** Biostratigraphic ranges of Albian Stage ammonites, planktic foraminifera and nannofossils zones in 'Vraconnian' sections in metric units in the Mont Risou section (VRACCS.1) and numerical ages in the global MIDK45CS.1 database; ages with asterisk are interpolated by plotting the 'Vraconnian' database, VRACCS.1 to the MIDK45CS.1 database.

AMÉDRO (2008) proposed that the base of the 'Vraconnian Stage' be defined by the FOs of Mortoniceras fallax and Neophlycticeras blancheti. He included three ammonite zones in this stage in ascending order: Mortoniceras (Mortoniceras) fallax Interval Zone, Mortoniceras (Subschloenbachia) perinflatum Total Range Zone, and the Arrhaphoceras (Praeschloenbachia) briacensis Interval Zone (Fig. 1). The composited dataset of his sections shows that M. inflatum first appears lower in the section than M. fallax (Fig. 5) because GALE et alii (1996) reported it lower in their Mont Risou section than did Amédro (2008, Fig. 11). The FO of A. briacensis is at the base of the Cenomanian Stage based on this set of sections. The ranges of Amédro's key zonal species (Amédro, 2008, Fig. 4) are dashed lines on Fig. 5 ; some ranges are similar and others are guite different from the ranges derived by graphic correlation of his data. S. dispar has a short range because it occurs in two sections, the Diégo well and

GALE's *et alii* Mont Risou section. Both *Mariella bergeri* and *Stoliczkaia clavigera* are low in the Mont Risou section (GALE *et alii*, 1996). Some species have longer ranges in AMÉDRO's dataset because they occur with species of other zones in condensed intervals in other sections not graphed, such as at the 'Vraconnian' stratotype (RENZ & JUNG, 1978) and near Drap in the Alpes-Maritimes, France (DELANOY & LATIL, 1988).

This graphic correlation experiment shows that the base of the *S. dispar* Zone and the FO of *M. perinflatum* are significantly lower (31 m) and older (380 kyr) than the FO of either *M. fallax* or *N. blancheti*. Thus the concept of a 'Vraconnian Stage' is not equal to the Dispar Zone. However the FOs of *M. perinflatum, M. fallax/N. blancheti*, and *A. briacensis* may be used to divide the Dispar Zone into three subzones.



**Figure 6**: Chronostratigraphic range chart of planktic foraminifera, calcareous nannofossils, and inoceramids in 'Vraconnian' composited database of key 'Vraconnian' sections. Vertical axis is meters in the Mont Risou section. Ages in Ma are interpolated by graphic correlation of the VRACCS.1 database with the MIDK45CS.1 database. Highest part of composite section not converted to ages. Foraminifer zones are defined by FO of named taxa. Nannofossil zones are defined by FO of *E. turriseiffelii* and *C. kennedyi* respectively. The FO of *Lithraphidites acutus* is in the middle part of the range of the Lower Cenomanian ammonite *Mantelliceras mantelli* in the Kalaat Senan section, Tunisia and 103.5 m above the base of *Rotalipora globotruncanoides* (MIDK.10 section; ROBASZYNSKI *et alii*, 1994).

Integration of key planktic foraminifera and calcareous nannofossils (Fig. 6) based on the limited dataset of AMÉDRO (2008) shows that *R. appenninica* is below the base of *Mortoniceras fallax*, and the first occurrence of *E. turriseiffelii* is slightly above it. In the larger MIDK45 dataset the FO of *E. turriseiffelii* is projected at 101.86 Ma and *R. appenninica* at 100.37 Ma, both of which are significantly older than the FO of *M. fallax* at 98.26 Ma. So neither pelagic species is useful as a proxy guide to the base of a 'Vraconnian Stage.'

Five inoceramid species are recorded in the sections at Mont Risou and at Folkestone (Fig. 6). *Actinoceramus concentricus, Actinoceramus sulcatus,* and *Actinoceramus subsulcatus* 

characterize the lower part of the Upper Albian and *Inoceramus anglicus* and *Inoceramus crippsi* characterize the Lower Cenomanian.

The Albian stage is divided into seven zones and twenty-five subzones. The ranges of key fossils that define these zones can be calibrated to numerical Ma ages by graphic plots to sections bearing dated bentonites and geochemical events. This process measures the durations of the zones as proposed by AMÉDRO and ROBASZYNSKI (2008). This database is anchored to bentonites in the U.S. Western Interior dated by OBRADOVICH (1993) and projected to the age of Magnetochron M0 at the base of the Aptian. As new radiometric ages are accrued this database can be tested and adjusted to accommodate new data.

			S. (F.) blancheti	98.26*	M. fallax	98.26*	R appenninica	
	Upper	M. inflatum	C. auritus	103,01	M. inflatum	98,64	100.52	
			M. inflatum	H.varicosum	103,03	M. pricei	104,16	R. ticinensis 101.83
			H. orbignyi	104,23			B. breggiensis	E.monechiae
			D.cristatum	105,54	D. cristatum	105,54	105.76	101.97
		E. lautus 106.23	A. daviesi	105,68				
			E. nitidus	105, 78				
			E.meandrinus	NA				
	Middle	E . Iori catus	M. subdelaruei	105,9				
	Ξ	107.16	D.niobe	106,35				
			A. intermedius	107, 16				
Albian		H. (H.) dentatus	H. (H.) spathi	107,6				
₹		107.60	L. lyelli	107,84				
	Lower	D. mammillatum 111.58 ອີ	L. pseudolyelli	NA				
			P. (I.) steinmanni	108,2				
			O. bulliensis	109,47				
			P. puzosianus	110,8				
			O. raulinianus	109,39				A. albianus 109.77
			C.floridum	111,31			T. præticinensis 110.93	T. orionatus 110.91
			S. kitcheni	NA			T.primula 111.61	
			D. perinflata	NA				
		L. tardefurc ata	L. (N.) regularis	110,94				
			L. tardefurcata	112,66				
		E. taruciult ata	L. schrammeni	NA			H. planispira 129.19	C. signum 114.05

**Figure 7**: Chronostratigraphic chart of the original Albian Stage. Ammonite zones from OGG *et alii* (2004), HOEDEMAEKER *et alii* (2003), HOEDEMAEKER & RAWSON (2000), HOEDEMAEKER *et alii* (1993), HANCOCK (1991), and OWEN (1984a, 1984b). Planktic foraminifera zones based on FOs from PREMOLI SILVA & SLITER (2002). Nannofossil zones based on FOs from BOWN *et alii* (1998) and BRALOWER *et alii* (1995). Numerical ages interpolated by graphic correlation of MIDK45 database (SCOTT *et alii*, 2000). NA indicates species not in the MIDK45 database.

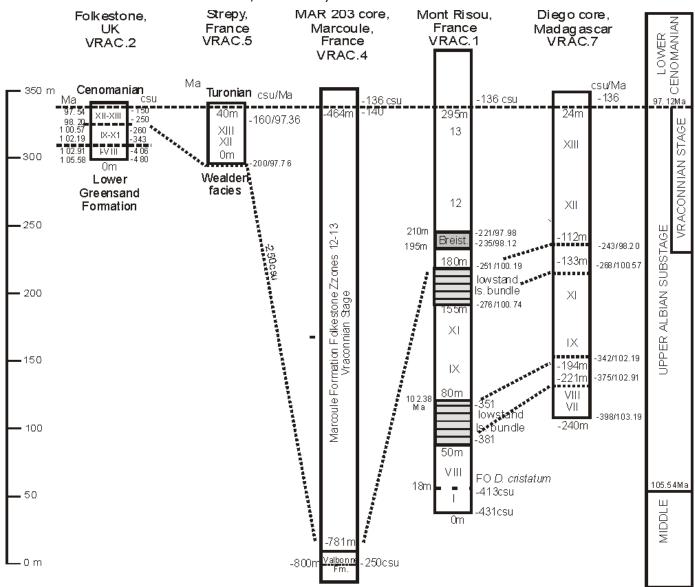
# Chronostratigraphic correlation of key sections

The graphic correlation method provides data for chronostratigraphic correlation of the key 'Vraconnian' sections (Fig. 8). The proposed 'Vraconnian Stage' correlates with the upper part of the Upper Albian Substage (Fig. 4). The cross section datum is the Albian/Cenomanian stage boundary as defined by the FO of *R. globotruncanoides*. AMÉDRO used the FOs of *Mortoniceras fallax* and *Neophlycticeras blancheti* to define the base of the 'Vraconnian', which is approximated by the -250 m position

in the VRACCS.1 database. This position correlates with the unconformity at the base of zones XII-XIII in the Folkestone section and with the transgressive facies between -800 and -781 m in the MAR 203 core at Marcoule. The same time line also correlates within the lowstand limestone bundles in the Mont Risou and Diégo core. The entire interval of the Bracquegnies Formation in the Strépy boatlift section and in the Harchies N° 1 well (AméDRO, 2008, Fig. 17) correlates with Folkestone zones XII-XIII. The organic-rich BREISTROFFER interval in the Mont Risou section lies within the lower part of the transgressive interval equivalent to zone XII; it may represent maximum flooding. In the Mont Risou section a lower bundle of bioclasticglauconitic limestone from about 50 to 80 m (AMÉDRO, 2008, Fig. 11) correlates with the lower condensed section between zones VIII and IX at Folkestone.

The thickness of the 'Vraconnian Stage' varies greatly among the sections as noted by (AMÉDRO, 2008). In the MAR 203 core at Marcoule the equivalent 'Vraconnian' interval is 317 m thick, eight times than thicker than at the Strépy section, more than twenty-three times thicker than at Folkestone, and nearly

160 times thicker than in the 'Vraconnian' reference section in Switzerland. The rates of sediment accumulation varied from 4.5 m/myr at Folkestone to 37.6 m/myr at Mont Risou, and 111.6 m/myr at Marcoule. The rate of accumulation is based on the compacted section and is not a sedimentation rate. These rates are based on the duration of about 3 myr for the 'Vraconnian' interval. This great range in rates is based on very different basin subsidence histories and tectonic conditions of each section.



**Figure 8**: Stratigraphic correlation of key 'Vraconnian' sections using base of Cenomanian Stage as datum. CSU values are meters in the Mont Risou section of GALE *et alii* (1996, MIDK.24). Ages interpolated by graphic correlation of the VRACCS.1 database with the MIDK45CS.1 database. Age of lower part of Valbonne Formation below intra-formational unconformity at -800 m not projected because of the absence of fossils.

## Re-examination of the rationale for a 'Vraconnian Stage'

#### 1. The interval is mappable

This criterion is essential to the definition of lithostratigraphic units such as formations (NACSN, 2005). However, it is not part of the definition of a stage, in which lithofacies change from basin to basin. The lithologies that comprise the 'Vraconnian' interval are quite different from section to section (AMÉDRO, 2008), and thus do not make up a mappable lithostratigraphic unit.

# 2. The interval records an important eustatic event

Indeed the 'Vraconnian' interval records a third-order three myr depositional cycle of transgression and regression on a regional even global scale. This feature, however, defines sequence stratigraphic units, not stages (NASCN, 2005). The Upper Albian Stage records five such sequences of this scale (Scort et alii, 2003), but it would be impractical to divide the Albian into five stages.

#### 3. The interval has a distinctive and diverse

#### fossil assemblage

This property is an essential feature of a stage concept. Three species of Mortoniceras and one species of Stoliczkaia comprise the 'Vraconnian Stage' according to AMÉDRO (2008) and Amédro & Robaszynski (2008). Amédro (2008) characterizes the 'Vraconnian' by the abrupt diversification of heteromorph ammonites of the Turrilitidae, Hamitidae. Anisoceratidae, and Baculitidae in the condensed La Vraconne section, where they comprise 60% of the specimens. However, species of three of these families appear earlier in the Late Albian between 102.47 and 98.64 Ma (Fig. 5) earlier than the FO of Mortoniceras fallax and Neophlycticeras blancheti.

The three heteromorph species restricted to the 'Vraconnian' in Amédro's database (2008) are primarily found in Western Europe. In the Carpatho-Balkan region of Eastern Europe the 'Vraconnian' is represented by a condensed interval of glauconitic and phosphatic sandy limestone less than one meter thick; the only ammonite species of the zone is Stoliczkaia notha (KUTEK & MARCINOWSKI, 1996). One North American section, Dry Creek in northern California (Amédro, 2008, Fig. 24), yields three ammonite species of the Dispar Zone, only one of which, *Lechites gaudini*, is found at the type section of the 'Vraconnian' in Switzerland (RENZ & JUNG, 1978). Few species characteristic of the 'Vraconnian' are found outside of Western Europe. The ammonite assemblage is not widespread in the Tethyan or Boreal Realms.

## 4. The interval duration is similar to that of

## other stages

The proposed duration of the 'Vraconnian Stage' is 2-3 myr, which is equivalent to that of the Santonian Stage. However the durations of Cretaceous stages vary from 2.3 to 13 myr (OGG *et alii*, 2004) and duration is not a criterion for defining a stage.

#### 5. The interval locally is quite thick

Sections bearing the 'Vraconnian' fauna are locally thicker than the underlying part of the Albian. The thickness difference is highly variable from basin to basin and within basins. Such thickness differences are found between condensed sections and coeval basin margin and basin center sections of many zones.

## Conclusions

The diverse ammonite assemblage in the uppermost part of the Upper Albian Substage comprises a distinctive zone in Western Europe that can be subdivided into three subzones. These subzones are recognized in many Tethyan and transitional Boreal sections in Europe. However, at the 'Vraconnian' type section in Switzerland Stoliczkaia dispar and Mortoniceras perinflatum are the only zonal named taxa present. The strata bearing the S. dispar Zone are bounded by unconformities in many sections and they are but one of five Upper Albian depositional sequences. The thickness of this sequence varies from condensed sections of two meters to expanded basinal sections more than 300 meters thick. The S. dispar Zone represents a time interval of about three myr, which is about the same duration as the briefest Cretaceous ages. This interval is very useful as a biostratigraphic unit and a third-order sequence stratigraphic unit. However this interval is not a practical chronostratigraphic unit such as a stage because its boundaries cannot be demonstrated to be synchronous and the interval is not isochronous, nor is it globally recognizable. Defining this interval as a stage equivalent to the Albian and Cenomanian stages would materially alter the concept of the Albian Stage by deleting its uppermost zone. The concept of 'Vraconnian Stage' is not a practical а subdivision of the Cretaceous System.

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